Cocker's
ARITHMETICK:

BEING

A Plain and familiar Method, ſuitable to the meaneſt Capacity for the full underſtanding of that Incomparable Art, as it is now taught by the ableſt School-Maſters in City and Country.

COMPOSED

By *Edward Cocker*, late Practitioner in the Arts of Writing, Arithmetick, and Engraving. Being that ſo long ſince promiſed to the World.

PERUSED and PUBLISHED

By *John Hawkins*, Writing-Maſter near St. *Georges* Church in *Southwark*, by the Author's correct Copy, and commended to the World by many eminent Mathematicians and Writing Maſters in and near *London*.

The Four and Twentieth Edition carefully Corrected, with Additions.

Licenſed *Sept.* 3. 1677. *Roger L'Eſtrange.*

LONDON:
Printed for *Eben. Tracy,* at the *Three Bibles* on *London-Bridge.* 1705.

TO his much Honoured Friends, *Manwaring Davies* of the *Inner Temple*, Eſquire, and Mr. *Humphry Davies* of St. *Mary Newington Butts*, in the County of *Surry*;

John Hawkins, As an Acknowledgment of Unmerited Favours; humbly Dedicateth this *Manual of Arithmetick*.

To the READER.

Courteous Reader,

I Having the Happineſs of an Intimate Acquaintance with Mr. *Cocker* in his Life-time, often ſolicited him to remember his Promiſe to the World, of Publiſhing his *Arithmetick*, but (for Reaſons beſt known to himſelf) he refuſed it; and (after his Death) the Copy falling accidentally into my Hands, I thought it not convenient to ſmother a Work of ſo conſiderable a moment, not queſtioning but it might be as kindly accepted, as if it had been preſented by his own Hand. The Method is familiar and eaſie, diſcovering as well the Theorick as the Practick of that Neceſſary Art of *Vulgar Arithmetick*: And in this new Edition there are many remarkable Alterations for the benefit of the Teacher or Learner, which I hope will be very acceptable to the World: I have alſo performed my Promiſe in Publiſhing the *Decimal Arithmetick*, which finds Encouragement to my Expectation, and the Bookſellers too, I am

Thine to ſerve thee,

John Hawkins.

Mr.

Mr. *Edward Cocker's*

PROEME or PREFACE.

BY the ſacred Influence of Divine Providence, I have been Inſtrumental to the benefit of many, by vertue of thoſe uſeful Arts, Writing *and* Engraving: *And do now with the ſame wonted alacrity caſt this my Arithmetical Mite into the Publick Treaſury, beſeeching the Almighty to grant the like Bleſſing to theſe as to my former Labours.*

Seven Sciences ſupremely excellent,
Are the chief Stars in Wiſdoms Firmament,
Whereof Arithmetick is one, whoſe worth
The Beams of Profit and Delight ſhines forth;
This crowns the reſt; this makes Man's mind complet;
This treats of Numbers, and of this we treat.

I have been often deſired by my intimate Friends to publiſh ſomething on this Subject; who in a pleaſing Freedom have ſignified to me that they expected it would be extraordinary. How far I have anſwered their Expectation, I know not; but this I know, that I have deſigned this Work not extraordinary abſtruſe or *profound, but have by all means poſſible within the Circumference of my Capacity, endeavoured to render it extraordinary uſeful to all thoſe, whoſe Occaſions ſhall induce them to make uſe of Numbers. If it be objected that the Books already publiſhed, treating of Numbers, are innumerable, I Anſwer, that's but a ſmall Wonder, ſince the Art is infinite. But that there ſhould be ſo many excellent Tracts of Practical Arithmetick extant, and ſo little practiſed, is to me a greater wonder; knowing that as Merchandiſe is the Life of the Weal-Publick, ſo Practical Arithmetick is the Soul of Merchandize. Therefore I do ingenuouſly profeſs, that in the beginning of this Undertaking, the numerous Concerns of the honoured Merchants firſt poſſeſſed my Conſideration: And how far I have accommodated this Compoſure for his moſt worthy Service, let his own profitable Experience be judge.*

Secondly, *For your Service, moſt excellent Profeſſors, whoſe Underſtandings ſoar to the Sublimity of the Theory and Practice of this Noble Science, was this Arithmetical Tractate compoſed; which you may pleaſe to imploy as a Monitor to inſtruct your young* Tyroes, *and thereby take occaſion to reſerve your precious Moments, which might be exhauſted that way, for your more important Affairs.*

Thirdly, *For you, the ingenious Off-ſpring of happy Parents, who will willingly pay the full Price of Induſtry and Exerciſe for thoſe Arts and choice Accompliſhments which may contribute to the Felicity of your future State. For you, I ſay, (ingenious Practitioners) was this Work compoſed, which may prove the Pleaſure of your Youth, and the Glory of your Age.*

Laſtly, *For you the pretended Numeriſts of this vapouring Age, who are more diſingeniouſly witty to propound unneceſſary Queſtions, than ingeniouſly judicious to reſolve ſuch as are neceſſary. For you was this Book compoſed and publiſhed, if you will deny your ſelves ſo much as to invert the ſtreams of your Ingenuity, and by ſtudiouſly conferring with the* Notes, Names, Orders, Progreſs, Species, Properties, Proprieties, Proportions, Powers, *Affections and Applications of* Numbers *delivered herein, become ſuch Artiſts indeed, as you now only ſeem to be. This Arithmetick ingeniouſly obſerved, and diligently practiſed, will turn to good account to all that ſhall be concerned in Accompts. All whoſe Rules are grounded on Verity and delivered with Sincerity. The* Examples *are built up gradually from the ſmalleſt Conſideration to the greateſt. All the Problems or Propoſitions are well weighed, pertinent, and clear, and not one* *of them throughout the Tract taken upon truſt; therefore now,*

Zoilus and *Momus* lie you down and die,
For theſe Inventions your whole force defie.

Edward Cocker.

Courteous Reader,

Being well Acquainted with the deceaſed Author, and finding him knowing and ſtudious in the Myſteries of Numbers and Algebra, of which he had ſome choice Manuſcripts, and a great Collection of Printed Authors in ſeveral Languages, I doubt not but he hath writ his Arithmetick ſuitable to his own Preface, and worthy Acceptation; which I thought to certify on a Requeſt to that purpoſe made to him that wiſheth thy Welfare, and the progreſs of Arts.

John Collens.

November 27th, 1677.

This Manual of Arithmetick is recommended to the World by Us whoſe Names are ſubſcribed, viz.

Mr. *John Collens*
Mr. *James Atkinſon* } Matth.
Mr. *Peter Perkins*
Mr. *Rich Lawrence*, Senior
Mr. *Eleazer Wigan*
Mr. *Rich. Noble of* Guilford
Mr. *William Norgate*

Mr. *William Maſon*
Mr. *Steph. Thomas*
Mr. *Peter Storey*
Mr. *Benj. Tichbourn*
Mr. *Joſeph Symmonds*
Mr. *Jerem. Milles*
Mr. *Joſiah Cuffley*
Mr. *John Hawkins*

And generally Approved by all Ingenious Artiſts,

A Table

A Table of the Contents of this BOOK.

	Chap.	Page
NOtation of Numbers	1	1
Of the natural diviſion of Integers, and the denomination of their parts	2	11
Of the Species or kinds of Arithmetick	3	19
Of the Addition of Whole Numbers	4	20
Of Subtraction of whole Numbers	5	29
Of Multiplication of whole Numbers	6	38
Of Diviſion of whole Numbers	7	47
Of Reduction	8	66
Of comparative Arithmetick, *viz.* the Relation of Numbers one to another	9	98
The ſingle Rule of 3 Direct	10	102
The ſingle Rule of 3 Inverſe	11	123
The double Rule of 3 Direct	12	130
The double Rule of 3 Inverſe	13	135
The Rule of 3 compoſed of 5 Numbers	14	139
Single Fellowſhip	15	141
Double Fellowſhip	16	145
Alligation Medial	17	148
Alligation Alternate	18	150
Reduction of Vulgar Fractions	19	158
Addition of Vulgar Fractions	20	168
Subtraction of Vulgar Fractions	21	170
Multiplication of Vulgar Fractions	22	172
Diviſion of Vulgar Fractions	23	173
The Rule of 3 Direct in Vulgar Fractions	24	175
The Rule of 3 Inverſe in Vulgar Fractions	25	177
Rules of Practice	26	178
The Rules of Barter	27	195
Queſtions in Loſs and Gain	28	196
Equation of Payments	29	200
Exchange	30	204
Single Poſition	31	209
Double Poſition	32	210

CHAP.

CHAP. I.

Notation of Numbers.

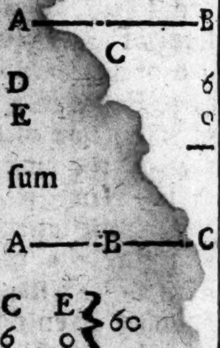
1 A*Rithmetick* is an Art of Numbring or Knowledge, which teacheth to number well, (*viz.*) the Doctrine of Accounting by Numbers. And there are divers Species and Kinds of *Arithmetick* and *Geometry*, the which we do intend to treat of in order; applying the Principles of the one to the Definitions of the other: For as Magnitude or Greatneſs is the Subject of *Geometry*, ſo Multitude or Number is the Subject of *Arithmetick*; and if ſo, then their firſt Principles and chief Fundamentals, muſt have like Definitions; or at leaſt, a Semblable Congruency.

2. Number is that by which the quantity of any thing is expreſſed or numbred; as the Unit is the number by which the quantity of one thing is expreſſed or ſaid to be one, and two by which it is named two, and $\frac{1}{2}$ half, by which it is named or called half, and the Root of 3, by which it is called the Root of 3, the like of any other.

3. Hence it is that Unit is number, for the part is of the ſame matter that is his whole, the Unit is part of the multitude of Units, therefore the Unit is of the ſame matter that is the multitude of Units; but the matter of the multitude of Units is Number, therefore the matter of Unit is Number; for elſe if from a given number, no number be ſubtracted, the Number given remaineth; let three be the number given; from which number ſubtract or take away one, (which as ſome conceive, is no number) therefore the

number given remaineth, that is to ſay, there remaineth three, which is abſurd.

4. Hence it will be convenient to examine from whence Number hath its riſe or beginning: Moſt Authors maintain, that Unit is the beginning of Number, and it ſelf no Number; but looking upon the Principles and Definitions in the firſt Rudiments of Geometry, we ſhall find, that the definition of a Point is in no way congruous with the definition of an Unit in Arithmetick; and therefore one, or Unit muſt be in the bounds or limits of Number, and conſequently the beginning of Number is not to be found in the number One; wherefore to make number and magnitude congruent in Principles, and like in Definitions, we make and conſtitute a Cypher to be the beginning of Number, or rather the medium between encreaſing and decreaſing Numbers, commonly called abſolute or whole Numbers, and negative or fractional Numbers, between which nothing can be imagined more agreeable to the definition of a Point in Geometry; for as a Point is an adjunct number, and it ſelf no line, ſo is (o) Cypher an adjunct of number, and it ſelf no number: And as a Point in Geometry cannot be divided or increaſed into parts; ſo likewiſe (o) cannot be divided or increaſed into parts; for as many Points though in number infinite do make no line, ſo many (o) Cyphers, though in number infinite do make no number. For the line A B cannot be increaſed by the addition of the Point C, neither can the number D be increaſed by the addition of the (o) Cypher E, for if you add nothing to 6, the Sum will be 6, (o) neither increaſing nor diminiſhing the number 6, but if it be granted that A B be extended or prolonged to the point C, ſo that A C be made a continued line, then A B is increaſed by the addition of the point C, in like manner



ner if we grant D 6 be prolonged to E (o) ſo that D E (60) be a continued number making 60, then 6 is augmented by the aid of (o) as to the conſtituting the number (60) ſixty; and furthermore that one or Unit is material and a number, and that (o) is the beginning of number is proved by all Authors, altho' indirectly, for the Tables of Sines and Tangents prove one degree to be a number, becauſe the Sine of 1 degree is 174524 (the Radius being 10000000) and the beginning of that Table is (o) and to it anſwereth 00000, *&c.*

5. Hence it is that number is not quantity diſcontinu'd, for all that which is but one quantity, is not quantity disjunct, (60) ſixty as it is a number, is one quantity, *viz.* one number (60) ſixty; therefore as it is number, it is not puantity disjunct; for number is ſome ſuch thing in magnitude, as humidity in Water; for as humidity extends it ſelf through all and every part of Water, ſo number related to magnitude, doth extend it ſelf through all and every part of magnitude. Alſo as to continued Water doth anſwer continued humidity, ſo to a continued magnitude doth anſwer a continued number. As the continued humidity of any intire Water, ſuffereth the ſame Diviſion and diſtinction that his Water doth; ſo the continued Number ſuffereth the ſame diviſion and diſtinction that his magnitude doth. From all which Conſiderations we might enlarge a further digreſſion concerning number and magnitude, by comparing the definitions of the one with the Principles of the other, for having found a (o) Cypher to be anſwerable in definition to a point in magnitude, we may very well conclude that number may be congruent to a line; as alſo the Figurative Number to be conſonant in definition with a Superfices, and Solid, *&c.* in the order of Geometrical Magnitudes.

6. The Characters or Notes by which Numbers are ſignified, or by which a Number is ordinarily expreſſed are theſe following, (*viz.*) o Cypher or nothing, 1 One, 2 Two, 3 Three, 4 Four, 5 Five, 6 Six, 7 Seven, 8 Eight, 9 Nine: The Cypher, which though of it

ſelf ſignifieth nothing, (*viz.*) expreſſeth not any certain or known quantity, but is the Beginning, Radix, or Root of Number, and the other nine Figures or Characters are called ſignificant Figures or Digits.

7. In numbers of any ſort, two things are to be conſidered, (*viz.*) Notation and Numeration.

8. Notation teacheth how to deſcribe any number by certain Notes and Characters, and to declare the value thereof being ſo deſcribed, and that is by Degrees and Periods.

9. A Degree conſiſts of three figures, *viz.* of three places comprehending Units, Tens, and Hundreds, ſo 365 is a degree, and the firſt figure (5) on the Right-hand, ſtands ſimply for its own value, being Units or ſo many Ones, (*viz.*) five; the ſecond in order from the Right, ſignifies as many times ten, as there are Units contained in it, (*viz.*) ſixty; the third in the ſame order ſignifies ſo many hundreds as it contains Units, ſo will the expreſſion of the Number be three hundred ſixty five; alſo 789, is ſeven hundred eighty nine, *&c.*

10. A Period is when a Number conſiſts of more than three figures, or places, and whoſe proper order is to prick or diſtinguiſh every third place beginning at the Right-hand, and ſo on to the Left; ſo the Number 63452 being given, it will be diſtinguiſhed thus, 63.452, and expreſſed thus, ſixty three thouſand four hundred fifty two, likewiſe 4.578.235.782, being diſtinguiſhed as you ſee, will be expreſſed thus, Four thouſand five hundred ſeventy eight millions, two hundred thirty five thouſand, ſeven hundred eighty two.

11. Number is either Abſolute or Negative.

12. An Abſolute, or intire, whole, increaſing number, is that which by annexing of another Figure or Cypher, it becomes ten times as much as it ſtood for before; and if two Figures or Cyphers be annexed, it makes it a hundred times more than it ſtood for before, *&c.* as if you annex to the Figure 6 a Cypher, then it will become (60) ſixty: So if two Cyphers are

annexed, then it will be (600) ſix hundred, and if you do annex to it a (4) four, then it will be (64) ſixty four; and if you annex (78) ſeventy eight, it will be then (678) ſix hundred ſeventy eight, and ſo on: By annexing more Figures or Cyphers, it will encreaſe in a decuple proportion *ad Infinitum.*

13. A Negative, or Broken, Fractional, Decreaſing Number, is that which by prefixing a Point or Prick towards the Left-hand its value is decreaſed from ſo many Units, to ſo many tenth parts of any thing, and if a point and (0) Cypher, or a Digit be prefixed, it will be then ſo many hundred parts, and if a point and two Cyphers or Digits be prefixed, its Value is decreaſed to be ſo many thouſand parts; as if you would prefix before the figure 3 a point (.) or prick thus (.3) it is then decreaſed from 3 Units or Integers, to (3) three tenth parts of an Unit or Integer; and if you prefix a Point and Cypher thus (.03) it is decreaſed from 3 Integers to 3 hundred parts of an integer, and by this means 5 *l.* Abſolute, by prefixing of a point will be decreaſed to 5 *l.* Negative, which is 5 tenth parts of a Pound, equal in value to ten Shillings, and ſo by prefixing of more Cyphers or Digits, its value is decreaſed in a decuple proportion *ad Infinitum.* As in the following Scheme, or rather order of Numbers, we have placed (0) Cypher in its due place and order, as it is both the beginning and medium of Number; for going from (0) towards the Left-hand you deal with intire, abſolute, whole, increaſing Numbers.

Increaſing Numbers.					*Decreaſing Numbers.*			
29	876	543	256	2 1 0 1 2	345	678	976	3
mm	mmm	mmm	mmm	CXUXC	mmm	mmm	mmm	m
mm	mmm	mmm	CX		XC	mmm	mmm	m
mm	mmm	CX				XC	mmm	m
mm	CX						XC	
X								

But going from (0) the place of Units towards the Right-hand, you meet with broken, negative, fractional and decreaſing Numbers. And hence it follows that

Multiplication encreaſeth the product in abſolute Numbers, but decreaſeth the product in negative Numbers. Alſo Diviſion decreaſeth the Quotient in whole Numbers, and increaſeth it in negative or fractional Numbers.

14. An abſolute, entire, whole, increaſing *Number*, hath always a point annexed towards the right-hand; and therefore,

15. A negative, broken, decimal, decreaſing *Number*, hath always a point prefixed before it towards the Left-hand. When we expreſs Integers or whole *Numbers*, as 5 *Pounds*, 5 *Feet*, 26 *Men*, we uſually annex a

l. feet. men. inch.
point or prick after the number thus, 5. 5. 26. 347.
But when we expreſs Decimals, or Numbers that are denied to be entire, as decreaſing *Numbers*, we do commonly prefix a point or prick before the ſaid Decimal or decreaſing *Number*, thus (.3), that is 3 tenths, or 3 primes, .03, that is 3 hundredths, or 3 ſeconds.

16. A whole or abſolute *Number* is an Unit, or a compoſed multitude of Units, and it is either a prime or elſe a compounded *Number*.

17. Prime *Numbers* amongſt themſelves are thoſe which have no multitude of Units for a common meaſurer as 8 and 7, or 10 and 13, becauſe not any multitude of Units can equally meaſure or divide them without a Remainder.

18. Compound *Numbers* amongſt themſelves are thoſe which have a multitude of Units for a common meaſurer, as 9 and 12, becauſe 3 meaſures them exactly, and abbreviates them to 3, and

19. A broken *Number* commonly called a Fraction, is a part or parts of a whole *Number*, *viz*. a part of an Integer, as $\frac{1}{3}$ one third, is one third part of an Unit.

20. A broken *Number* or Fraction, conſiſts of 2 parts, *viz*. the Numerator and the Denominator.

21. The Numerator and Denominator of a Fraction, are ſet one over the other, with a line between them; and the Numerator is ſet above the line, and expreſſeth the parts therein contained.

22. The Denominator of a Fraction is the inferiour *Number* placed below the line, and expreſſeth the number of parts into which the Unit or Integer is divided; as let $\frac{3}{4}$ be the Fraction given, ſo ſhall 3 be the numerator, and doth expreſs or *number* the multitude of parts contained in this Fraction; for $\frac{3}{4}$ is a Fraction compoſed of Fourths or Quarters; and the figure 3 in *numbring* ſhews us, that in that Fraction there are 3 of thoſe fourth parts or quarters; alſo in the ſame Fraction $\frac{3}{4}$, 4 is the *Denominator*, and doth expreſs the quality of the Fraction, *viz.* that the whole, or Integer, is here divided into 4 equal parts.

23. A broken *number* is either proper or improper, *viz.* proper, when the *Numerator* is leſſer than the *Denominator*? ſo $\frac{3}{4}$ is a perfect proper Fraction, but an improper Fraction hath its *Numerator* greater, or at leaſt equal to the *Denominator*; thus $\frac{13}{8}$ is an improper Fraction, the Reaſon is given in the definition.

24. A proper broken *Number* is either *Simple* or *Compound*, *viz. Simple*, when it hath one *denomination*; and *Compound*, when it conſiſteth of divers *Denominatoons*. If $\frac{3}{4}$ *l.* $\frac{6}{12}$, $\frac{25}{100}$ *l.* were given, we ſay they are either of them ſingle or *ſimple Fractions*, becauſe they conſiſt but of one *numerator* and one *denominator*; but if $\frac{3}{4}$ of $\frac{8}{12}$ of $\frac{15}{100}$ of a pound Sterling were given, we ſay, that is a *compound broken Number*, or *Fraction*, becauſe the expreſſion and repreſentation conſiſteth of more *Denominations* than one; and ſuch by ſome are called *Fractions of Fractions*, and they have always this Particle (of) between them.

25. When a ſingle *broken Number* or *Fraction* hath for his *denominator* a *number* conſiſting of a Unit in the firſt place towards the Left-hand, and nothing but Cyphers from the Unit towards the Right-hand, it is then the more aptly and rightly called a *Decimal Fraction*; under this Head are all our decreaſing *Numbers* placed, and in our 13*th Definition* called Negative, and by that order there preſcribed, we order them to be *Decimals*, by ſigning a point or prick before them, or the *Numerator* rejecting the *Denominator*: Therefore ac-

cording to our laſt Rule, $\frac{5}{10}$, $\frac{5}{100}$, $\frac{25}{100}$, $\frac{25}{1000}$, are ſaid to be *Decimals*; and a *Decimal Fraction* may be expreſſed without its *Denominator* (as before) by prefixing a point or prick before the *Numerator* of the ſaid *Fraction*, and then ſhall the former *Fraction* $\frac{5}{10}$, and $\frac{25}{100}$, ſtand thus .5, and .25.

But oftentimes, as in the ſecond and fourth *Fractions* $\frac{5}{100}$ and $\frac{25}{1000}$, a prick or point will not do without the help of a Cypher or Cyphers prefixed before the ſignificant figures of the *numerator*, and therefore when the *numerator* of a *decimal Fraction*, conſiſteth not of ſo many places as the *denominator* hath Cyphers, fill up the void places of the *numerator*, with prefixing Cyphers before the ſignificant Figures of the *numerator*, and then ſign it for a *decimal*, ſo ſhall $\frac{5}{100}$ be .05, and $\frac{25}{1000}$, will be .025, and $\frac{72}{10000}$ will be .0072. Now by this we may eaſily diſcover the *denominator* having the *numerator*; for always the *denominator* of any *decimal Fraction* conſiſts of ſo many Cyphers, as the *numerator* hath places, with a Unit prefixed before the ſaid Cyphers, *viz.* under the point or prick.

26. A *Decimal Number* or *Fraction*, is that which is expreſſed by *Primes*, *Seconds*, *Thirds*, *Fourths*, &c. and is number decreaſing. Here inſtead of *Natural* and *Common Fractions*, as $\frac{3}{4}$ of a thing, we order the thing or Integer into *Primes*, *Seconds*, *Thirds*, *Fourths*, *Fifths*, *&c.* that our expreſſion may be conſonant to our former order.

27. In *Decimal Arithmetick* we always imagine (and it would be very commodious if it were really ſo) that all intire Units, Integers, and things are divided firſt into ten equal parts, and theſe parts ſo divided we call *Primes*: and ſecondly, we divide alſo each of the former *Primes* into other ten equal parts, and every of theſe diviſions we call *Seconds*; and thirdly, we divide each of the ſaid *Seconds* into ten other equal parts, and thoſe ſo divided we call *Thirds*; and ſo by decimating the former, and ſubdecimating theſe latter, we run on *ad infinitum*.

28. Let a pound Sterling, *Troy-weight*, *Averdu-*

pois-weight, *Liquid-Meaſure*, *Dry-Meaſure*, *Long-Meaſure*, *Time*, *Dozen*, or any other thing, or Integer be given to be *decimally* divided; in this notion premiſed we ought to let the firſt Diviſion be *Primes*, the next diviſion *Seconds*, the next *Thirds*, &c. So one pound ſterling being 20 ſhillings, which divided into ten equal parts, the value of each part will be 2 ſhillings; therefore one *Prime* of a pound ſterling will ſtand thus (.1) which is in value 2 ſhillings, three *Primes* will ſtand thus (.3) and that is in value 6 ſhillings. Again, a *Prime* or .1 being divided into ten equal parts, each of thoſe parts will be one *Second*, and is thus expreſſed, (.01) and its value will be found to be 2*d.* farthing, and $\frac{6}{10}$ of a farthing; and ſo will .05 ſignify one ſhilling, or five *Seconds*. And if .10 be divided into ten other eqnal parts, each of thoſe parts ſo divided will be *Thirds*, and will ſtand thus .01, and its value will be found to be .96 of a farthing, or $\frac{96}{100}$ of a farthing; and .009 *Thirds* will be 2 *d.* and .64 of a farthing, or $\frac{64}{100}$ of a farthing, *&c.* So that .375 *l.* will be found to repreſent 7*s.* and 6*d.*; for the 3 *Primes* are 6 ſhillings, and the 7 *Seconds* are 1*s.* 4*d.* and $\frac{8}{10}$ of a penny, and the 5 *Thirds* are 1 penny, and $\frac{2}{10}$ of a penny, both which added together make 7*s.* 6*d.*

29. If you put any bulk or body, repreſenting an Integer if it be *decimally divided*, then the parts in the firſt decimation are *Primes*, the next *Seconds*, and the next decimation is *Thirds*, the next *Fourths*, &c. As let there be given a Bullet of Lead, or ſuch like, whoſe weight let it be 50 *l. Troy*, this call an Unit, Integer, or thing, then with the like weight and matter, make 10 other, the which together will be equal to 50 *l.* and will weigh each of them 5 *l.* a piece, take of the ſame matter, and equal to 5 *l.* make 10 more, then each of thoſe will weigh 6 ounces a-piece; alſo, if again you take 6 ounces, and thereof make 10 other ſmall Bullets, each of them will weigh 12 penny weight *Troy*; and thus have you made *Primes*, *Seconds*, and *Thirds*, in reſpect of the Integer containing 50 *l. Troy*; and that 5 *Primes* is equal to the half maſs, and 2 *Primes* and

5 *Seconds* is a quarter of the maſs; and therefore 1 of the firſt diviſion, 2 of the ſecond diviſion, and 5 of the third diviſion, will be equal in weight to $\frac{1}{2}$ a quarter of the maſs, and contain 6 *l.* and 3 Ounces.

30. When a *Decimal Fraction* followeth a whole *Number*, you are to ſeparate or part the *Decimal* from the *whole Number*, by a point or prick; ſo if .75 followed the *whole Number* 32, ſet them thus 32.75. You ſhall find that divers Authors have divers ways in expreſſing mixt *numbers*, as thus, 32|75, or 32 $\frac{75}{100}$ or $32.\dot{7}\dot{5}$, or $32.|\underline{75}$, or 32;75, but you will find that 32.75 thus placed and expreſſed is fitteſt for Calculation.

31. A mixt *number* hath 2 parts, the whole and the broken; the whole is that which is compoſed of Integers, and the broken is a *Fraction* annexed thereunto. So the mixt *number* 36 $\frac{8}{12}$ being given, we ſay that 36 is the whole *number*, which is compoſed of Integers, and the $\frac{8}{12}$ is the broken *number* annexed, which ſheweth that one of the former Integers (of that 36) being divided into 12 parts, this $\frac{8}{12}$ doth expreſs 8 of thoſe 12 parts more belonging to the ſaid 36 Integers.

32. *Denominative Numbers* are of one, or of many, and thoſe are of divers ſorts and kinds, *viz.* *Singular*, called Unit, as 1; and *Plural*, called multitude, as 2, 3, 4, 5; *Single* of one kind only, called *Digits*, as 1, 2, 3, 4, 5, 6, 7, 8, 9, and *Compounds* of many, 10, 11, 12, *&c.* 102, 367, *&c.*

Proportional, as Single, Multiple, Double, Triple, Quadruple, *&c.* Denominate, as Pounds, Shillings, Pence; Undenominate, as 1, 2, 3, *&c.* Perfect, as 6, 28, 496, 8128, 130816, 2096128, *&c.* whoſe parts are equal to the numbers; Imperfect, unequal and more than the ſum, as 12 to 1, 2, 3, 4, 6. Imperfect, unequal and leſs than the ſum, as 8 to 1, 2, 4. Numbers Commenſurable and Incommenſurable, as 12 and 9 are Commenſurable, becauſe 3 meaſures them both.

But 6 and 17 are Incommenſurable, becauſe no one common *number* or *meaſure* can meaſure them Linear in form of a Line, as ………… Superficial in form of a Superficies or Plane, as : : : :, or ⋮ ⋮, *&c.* and number cubical or ſolid in form of a Cube. Theſe two latter are otherwiſe called figurative Numbers: There are alſo other Numbers called Tabular, as Sines, Tangents, Secants, *&c.* Others that be called Logarithms or borrowed Numbers, fitted to proportion for eaſe and ſpeedy Calculation of all manner of Queſtions.

CHAP. II.

Of the Natural Diviſion of Integers, and the ſeveral Denominations of the Parts.

1. BEfore we come to calculation or the ordering of *Numbers* to operate any Arithmetical Queſtion propoſed, we will lay down Tables of the denomination of ſeveral Integers; and after that (having mentioned the ſeveral ſpecies or kinds of Arithmetick) we ſhall immediately handle the ſpecies of Numeration, which are the main Pillars upon which the whole Fabrick of this Art is built.

Of Money, Weights. &c.

2. The leaſt Denomination or Fraction of Money uſed in *England* is a Farthing, from whence is produced the following Table, called the *Table of Coyn*, *viz.*

1	*Farth.*	make	1 *Farthing*
4	*Farth.*		1 *Penny*
12	*Pence*		1 *Shilling*
20	*Shill.*		1 *Pound*

And therefore

l	*s.*	*d.*	*qrs*
1	20	12	4
1	20	240	960
	1	12	48
		1	4

The firſt of theſe Tables, *viz.* that on the Left-hand, is plain and eaſy to be underſtood, and therefore wants no directions. In the ſecond Table above the line you have 1 *l.* 20 *s.* 12 *d.* 4 *qrs.* whereby is meant that 1 pound is equal to 20 ſhillings, and one ſhilling is equal to 12 pence, and one penny is equal to 4 farthings; under the line is 1 *l.* 20 *s.* 240 *d.* 960 *qrs.* which ſignifies one pound to contain 20 ſhillings, or 240 pence, or 960 farthings; in the ſecond line below that 1 *s.* 12 *d.* 48 *qrs.* the firſt ſtanding under the denomination of ſhillings, whereby is to be noted that one ſhilling is equal to 12 pence, or 48 farthings, and likewiſe that below that, one penny is equal in value to four farthings; underſtand the like reaſon in all the following Tables of Weight, Meaſure, Time, Motion and Dozen.

Of Troy Weight.

3. The leaſt Fraction or Denomination of Weight uſed in *England*, is a grain of Wheat gathered out of the middle of the Ear, and well dried; from whence are produced theſe following Tables of Weight, called *Troy-weight*.

32 *Grains of Wheat*	make	24 *Artificial Grains*
24 *Artificial Grains*		1 *Penny-weight*
20 *Penny-weight*		1 *Ounce*
12 *Ounces*		1 *Pound Troy-weight*

And therefore

l.	*oun.*	*p.w.*	*grains*
1	12	20	24
1	12	240	5760
	1	20	480
		1	24

Troy-weight ſerveth only to weigh Bread, Gold, Silver, and Electuaries; it alſo regulateth and preſcribeth a Form how to keep the Money of *England* at a certain ſtandard. The *Goldſmiths* have divided the ounce *Troy-weight* into other parts, which they generally call Mark-weight; the denominative parts thereof are as followeth, *viz.* A Mark (being an ounce *Troy*) is divided into 24 equal parts, called Carects, and each Carect into 4 Grains, ſo that in a Mark are 96 Grains; by this weight they diſtinguiſh the different fineneſs of their Gold; for if to the fineneſs of Gold be put 2 Carects of Alloy (which is of Silver, Copper, or other baſer Metal, with which they uſe to mix their Gold or Silver to abate the fineneſs thereof) both making when cold but an ounce, or 24 Carects, then this Gold is ſaid to be 22 Carects fine, for if it come to be refined the 2 Carects of Alloy will fly away, and leave only 22 Carects of pure Gold, the like to be conſidered of a greater or leſſer quantity; and as the fineneſs of Gold is eſtimated by Carects, ſo the fineneſs of Silver is diſtinguiſh'd by ounces; for if a pound of it be pure, and loſeth nothing in the Refining, ſuch Silver is ſaid to be twelve ounces fine; but if it loſeth any thing, it is ſaid to contain ſo much fineneſs as the loſs wanteth of 12 ounces, as if it loſe an ounce, it is ſaid to be 11 ounces fine, and if it loſe one ounce 14 penny-weight, then it is ſaid to be 10 ounces 6 penny-weight fine, and that which loſeth 2 ounces 4 penny-weight 16 grains, is ſaid to be 9 ounces 15 penny-weight 8 grains fine, *&c.* the like of a greater or leſſer quantity.

Of Apothecaries Weights.

4. The *Apothecaries* have their Weights deduc'd from *Troy-weight*, a pound *Troy* being the greateſt Integer, a Table of whoſe diviſion and ſub-diviſion followeth, *viz.*

1 *pound*	makes	12 *ounces*
1 *ounce*		8 *drams*
1 *dram*		3 *ſcruples*
1 *ſcrup.*		20 *grains*

And therefore

l.	*oun.*	*drams*	*ſcrup.*	*gr.*
1	12	8	3	20
1	12	96	288	5760
	1	8	24	480
		1	3	60
			1	20

5. Thus much concerning *Troy-weight*, and its derivative weights (which as was ſaid before) ſerveth to weigh Bread, Gold, Silver, and Electuaries; now beſides *Troy-weight* there is another kind of weight uſed in *England*, commonly known by the name of *Averdupois-weight* (a pound of which is equal to 14 ounces 12 penny-weight *Troy-weight*) and it ſerveth to weigh all kinds of Grocery Wares, as alſo Butter, Cheeſe, Fleſh, Wax, Tallow, Roſin, Pitch, Lead, and all ſuch kind of Garble, the Table of which weight is as followeth.

The Table of Averdupois-weight.

4 *quarters of a dram*	make	1 *dram*
16 *drams*		1 *ounce*
16 *ounces*		1 *pound*
28 *pounds*		1 *quarter of a hundred*
4 *quarters*		1 *hundred weight or* 112 *l.*
20 *hundred*		1 *tun*

And therefore,

Tun	*C.*	*qrs*	*l.*	*oun.*	*drams*	*qrs.*
1	20	4	28	16	16	4
1	20	80	2240	35840	573440	2293760
	1	4	112	1792	28672	114688
		1	28	448	7168	28672
			1	16	256	1024
				1	16	64
					1	4

Wooll is weighed with this Weight, but only the Diviſions are not the ſame; A Table whereof followeth.

A Table of the denominative parts of Wooll-weight.

7 *pounds*	make	1 *clove*
2 *cloves*		1 *ſtone*
2 *ſtones*		1 *todd*
6 *todd* 1 *ſtone*		1 *wey*
2 *weys*		1 *ſack*
12 *ſacks*		1 *laſt*

And therefore,

Laſt	*Sack*	*Wey*	*Todd*	*Stone*	*Cloves*	*l.*
1	12	2	$6\frac{1}{2}$	2	2	7
1	12	24	156	312	624	4368
	1	2	13	26	52	364
		1	$6\frac{1}{2}$	13	26	182
			1	2	4	28
				1	2	14
					1	7

Note, That in ſome Counties, the *Wey* is 256 *l. Averdupois*, as is the *Suffolk* Wey; but in *Eſſex* there is 336 *l.* in a Wey.

6. The leaſt denominative part of *Liquid Meaſure* is a pint, which was formerly taken from *Troy-weight*, (a pound of Wheat *Troy-weight* making a pint of *liquid Meaſure*) but in regard of the difference between the Brewers and the Farmers of Her Majeſty's Exciſe concerning the gauging of Veſſels occaſioned by the different Opinions of Artiſts, concerning the ſolid inches in a Gallon; it was lately decided by Act of Parliament, the Statute making 282 ſolid Inches in a Beer Gallon, and 231 in a Wine-meaſure, and conſequently the pint Beer-meaſure to contain $35\frac{1}{4}$ ſolid Inches, and the pint Wine-meaſure to contain $28\frac{7}{8}$ cubical or ſolid Inches, from whence is drawn the following Table.

The Table of Liquid Meaſure.

$35\frac{1}{4}$ *cubical Inches*	make	1 *pint beer-meaſure*
$28\frac{7}{8}$ *cubical Inches*		1 *pint wine-meaſure*
2 *pints*		1 *quart*
2 *quarts*		1 *pottle*
2 *Pottles*		1 *gallon*
8 *gallons*		1 *firk. of ale, ſoap or herr*
9 *gallons*		1 *firkin of beer*
10 *gallons and a half*		1 *firk. of Salmon or Eels*
2 *firkins*		1 *kilderkin*
2 *kilderkins*		1 *barrel*
42 *gallons*		1 *tierce of wine*
63 *gallons*		1 *hogſhead*
2 *hogſheads*		1 *pipe or butt*
2 *pipes or butts*		1 *tun of wine*

And therefore

Tun	*pipes*	*hhds*	*gall.*	*pints*
1	2	2	63	8
1	2	4	252	2016
	1	2	126	1008
		1	63	504
			1	8

7. The leaſt denominative part of Dry Meaſure is alſo a pint, and this is likewiſe taken from *Troy-weight*. The Table of whoſe diviſion followeth.

The Table of Dry Meaſure.

1 *pound Troy*	makes	1 *pint*
2 *pints*		1 *quart*
2 *quarts*		1 *pottle*
2 *pottles*		1 *gallon*
2 *gallons*		1 *peck*
4 *pecks*		1 *buſhel*
4 *buſhels*		1 *comb*
2 *combs*		1 *quarter*
4 *quarters*		1 *chaldron*
5 *quarters*		1 *wey*
2 *weys*		1 *laſt*

And therefore,

laſt	*wey*	*qrs*	*com.*	*buſh.*	*pecks*	*gall.*	*pints*
1	2	5	2	4	4	2	8
1	2	10	20	80	320	640	5120
	1	2	10	40	160	320	2560
		1	5	8	32	64	512
			1	4	16	32	256
				1	4	8	64
					1	2	16
						1	8

8. The leaſt denominative part of *Long Meaſure* is a Barly-corn well dried, and taken out of the middle of the Ear; whoſe Table of parts followeth.

The Table of Long Meaſure.

3 *Barly corns*	make	1 *inch*
12 *inches*		1 *foot*
3 *feet*		1 *yard*
3 *feet 9 inches, or a yard and quarter*		1 *ell Engliſh*
6 *feet*		1 *fathom*
5 *yards and a half*		1 *pole, perch or rod*
40 *poles or perches*		1 *furlong*
8 *furlongs*		1 *Engliſh mile*

And therefore,

mile	*furl.*	*poles*	*yards*	*feet*	*inches*	*barly-corns*
1	8	40	5½	3	12	3
1	8	320	1760	5280	63360	190080
	1	40	220	660	7920	23760
		1	5½	16½	198	594
			1	3	36	108
				1	12	36
					1	3

And note that the yard, as alſo the ell, is uſually divided into 4 quarters, and each quarter into 4 Nails.

Note alſo that a Geometrical Pace is 5 feet; and there are 1056 ſuch Paces in an *Engliſh* mile.

2. The parts of the Superficial Meaſures of Land are ſuch as are mentioned in the following Table, *viz.*

The Table of Land Meaſure.

40 *ſquare Poles or Perches*	make	1 *Rood, or quarter of an Acre*
4 *Roods*		1 *Acre*

By the foregoing *Table of Long Meaſure*, you are inform'd what a Pole, or (which is all one) Perch is; and by this that 40 ſquare Perches are 1 Rood. Now by a ſquare Perch is a ſuperfices very aptly reſembled by a ſquare Trencher, every ſide thereof being a Perch, or 5 Yards and a half in length, 40 of them is a Rood, and 4 Roods an Acre. So that a Superfices that is 40 Perches long and 4 broad is an Acre of Land, the Acre containing in all 160 ſquare Perches.

10. The leaſt denominative part of Time is a *Minute*, the greateſt Integer being a *Year*; from whence is produced this following Table.

The Table of Time.

1 *Minute*	make	1 *Minute*
60 *Minutes*		1 *Hour*
24 *Hours*		1 *Day natural*
7 *Days*		1 *Week*
4 *Weeks*		1 *Month*
13 *Months*, 1 *day*, 6 *hou.*		1 *Year*

But the Year is uſually divided into 12 unequal *Kalendar Months*, whoſe Names and the number of Days that they contain, follow, *viz.*

	Days
January	31
February	28
March	31
April	30
May	31
June	30
July	31
Auguſt	31
September	30
October	31
November	30
December	31

So that the Year containeth 365 Days, and 6 Hours, but the 6 Hours is not reckoned but only every 4th Year, and then there is a Day added to the latter end of *February*, and then it containeth 29 Days, and that Year is called Leap-year, and containeth 366 Days.

And here note, that as the Hour is divided into 60 Minutes, ſo each Minute is ſubdivided into 60 Seconds, and each Second into 60 Thirds, and each Third into 60 Fourths, *&c.*

The Tropical Year by the exacteſt obſervations of the moſt accurate *Aſtronomers* is found to be 365 Days, 5 Hours. 49 Minutes, 4 Seconds, and 21 Thirds.

CHAP. III.

Of the Species or Kinds of Arithmetick,

1. ARithmetick is either Natural, Artificial, Analytical, Algebraical, Lineal or Inſtaumental.

2. Natural Arithmetick is that which is performed by the Numbers themſelves; and this is either Poſitive or Negative. Poſitive which is wrought by certain infallible Numbers propounded, and this either Single or Comparative; Single which conſidereth the nature of *Numbers* ſimply by themſelves; and Comparative, which is wrought by *Numbers* as they have relation one to another. And the Negative part relates to the Rule of *Falſe*.

3. Artificial (by ſome called Logarithmetical) Arithmetick is that which is performed by artificial or borrowed Numbers invented for that purpoſe, and are called Logarithms.

4. Analytical Arithmetick, is that which ſhews from a thing unknown to find truly that which is ſought always keeping the Species without Change.

5. Algebraical Arithmetick, is an obſcure and hidden Art of Accompting by Numbers in reſolving of hard Queſtions.

6. Lineal Arithmetick, is that which is performed by lines fitted to proportions, as Geometrical Projections.

7. Inſtrumental Arithmetick, is that which is performed by Inſtruments fitted with Circular and Right Lines of Proportion, by the motion of an Index, or otherwiſe.

8. The Parts of Single Arithmetick are Numeration and the Extraction of Roots.

9. Numeration is that by which certain known Numbers propounded, we diſcover another Number unknown.

10. Numeration hath four Species, *viz.* *Addition, Subtraction, Multiplication* and *Diviſion.*

CHAP. IV.

Of Addition of Whole Numbers.

1. ADdition is the Reduction of two or more *numbers* of like kind together into one Sum or Total. Or it is that by which divers numbers are added together, to the end that the Sum or Total value of them all may be diſcovered.

The firſt number in every *Addition* is called the *addible number*, the other, the *number* or *numbers* added, and the number invented by the *Addition* is called the *Aggregate* or *Sum* containing the value of the *Addition.*

The Collation of the numbers, is the right placing of the numbers given reſpectively to each denomination, and the Operation is the artificial adding of the numbers given together in order to the finding out of the *Aggregate* or *Sum.*

2. In *Addition*, place the numbers given reſpectively the one above the other, in ſuch ſort, that the like degree, place or denomination, may ſtand in the ſame Series, *viz.* Units under Units, Tens under Tens, Hundreds under Hundreds, *&c.* Pounds under Pounds, Shillings under Shillings, Pence under Pence, *&c.* Yards under Yards, Feet under Feet, *&c.*

3. Having thus placed the numbers given (as before) and drawn a line under them, add them together, beginning with the leſſer denomination, *viz.* at the Right-hand, and ſo on, ſubſcribing the ſum under the line reſpectively; as for Example.

Let there be given 3352 and 213 and 133 to be added together, I ſet the Units in each particular number under each other, and ſo likewiſe the Tens under the Tens, *&c.* and draw a line under them, as in the Margent; then I begin at the place of Units, and add them together upwards, ſaying, 3 and 3 are 6 and 2 make 8, which I ſet under the line, and under the ſame Figures added together; then I proceed to the next place, being the place of Tens, and add them up in the ſame manner as I did the place of Units, ſaying, 3 and 1 are 4 and 5 are 9, which I likewiſe ſet under the line reſpectively; then I go to the place of Hundreds, and add them up as I did the other, ſaying, 1 and 2 are 3 and 3 are 6, which I alſo ſet under the line; and laſtly, I go to the place of Thouſands, and becauſe there are no other Figures to add to the 3, I ſet it under the line in its reſpective place, and ſo the work is finiſhed; and I find the ſum of the 3 given numbers to be 3698.

$$\begin{array}{r}3352\\213\\133\\\hline 3698\end{array}$$

4. But if the Sum of the Figures of any Series exceeds ten, or any number of tens, ſubſcribe under the ſame the Exceſs above the tens, and for every ten carry one to be added to the next Series towards the Left-hand. and ſo go on till you have finiſhed your addition; always remembring, that how great ſoever the ſum of the Figures of the laſt Series is, it muſt all be ſet down under the line reſpectively. So 3678 being given to be added to 2357, I ſet them down as is before directed, and as you ſee in the Margent, with a line drawn under them, then I begin and add them together, ſaying, 7 and 8 are 15, which is 5 above 10, wherefore I ſet 5 under the line, and carry 1 for the 10 to be added to the next ſeries, ſaying, 1 that I carried and 5 is 6, and 7 are 13, wherefore I ſet down 3 and carry 1 (for the ten) to the next ſeries, then I ſay 1 that I carried and 3 are 4, and 6 are ten, now becauſe it comes to juſt ten and no more, I ſet 0 under the line and carry 1 for the 10 to the next, and ſay, 1 that

$$\begin{array}{r}3678\\2357\\\hline 6035\end{array}$$

that I carried and 2 are 3, and 3 are 6, which I ſe down in its reſpective place, thus the addition is ended, and the total Sum of theſe *Numbers* is found to be 6035, ſeveral Examples of this kind follow.

Numbers to be added
354867
573846
785946
347205
Sum 2061864

Numbers to be added
748647
465834
76483
648300
Sum 1939264

Numbers to be added
45346
38074
8437
923
76
Sum 92856

5. If the Numbers given to be added, are contained under divers denominations; as of *Pounds*, *Shillings*, *Pence* and *Farthings*; or of *Tuns*, *Hundreds*, *Quarters*, *Pounds*, &c. Then in this caſe having diſpoſed of the *Numbers*, each denomination under other of like kind; beginning at the leaſt denomination, (minding how many of one denomination do make an Integer of the next) and having added them up, for every Integer of the next greater denomination that you find therein contained, bear an Unit in mind to be added to the ſaid next greater denomination, expreſſing the exceſs reſpectively under the line, proceed in this manner until your Addition be finiſhed; the following Examples will make the Rule plain to the Learner. Thus theſe ſeveral Sums being given to be added, *viz.* 136 *l.* 13 *s.* 4 *d.* 2 *qrs.* and 79 *l.* 07 *s.* 10 *d.* 3 *qrs.* and 33 *l.* 18 *s.* 09 *d.* 1 *qr.* alſo 15 *l.* 09 *s.* 05 *d.* 0 *qrs.* The Numbers being diſpoſed according to order will ſtand as in the Margent. Then I begin at the denomination of Farthings, and

l.	*s.*	*d.*	qrs.
136	13	04	2
79	07	10	3
33	18	09	1
15	09	05	0
265	09	05	2

and add them up, ſaying 1 and 3 are 4 and 2 make 6, now I conſider that 6 Farthings is 1 Penny and 2 Farthings, wherefore I ſet down the 2 Farthings in its place under the line, and keep 1 in mind to be added to the next denomination of Pence; then I go on, ſaying 1 that I carried and 5 are 6, and 9 are 15 and 10 are 25, and 4 are 29, now I conſider that 29 pence are 2 Shillings and 5 pence, wherefore I ſet the 5 pence in order under the line, and keep 2 in mind for the 2 Shillings, to be added to the Shillings; then I go on, ſaying that 2 I carried and 9 are 11, and 18 are 29, and 7 are 36, and 13 are 49; then I conſider that 49 ſhillings are 2 pounds and 9 ſhillings, wherefore I ſet the 9 ſhillings under the line, and carry 2 for the 2 pounds, to the next and laſt denomination of pounds, and proceed, ſaying 2 that I carried and 5 make 7, and 3 are 10, and 9 are 19, and 6 are 25; then I ſet down 5, and carry 2 for the tens, and proceed, ſaying, 2 that I carly and 1 is 3, and 3 are 6, and 7 are 13, and 3 make 16; and I ſet down 6 and carry 1 for the 10, and go on, ſaying 1 that I carried and 1 are 2, which I ſet in its place under the line, and the Work is finiſhed; and thus I find the Sum of the foreſaid *Numbers* to be 265 *l.* 9 *s.* 5 *d.* 2 *qrs.* This to the Ingenious Practitioner is ſufficient; but I ſhall (for the further illuminating of weaker apprehenſions) explain the operation of another Example in *Troy-weight*; and here the Learner muſt take notice of the Table of *Troy-weight* mentioned or ſet down in the third Section of the ſecond Chapter. The *Numbers* given in this Example are 38 *l.* 7 *oz.* 13 *p. w.* 18 *gr.* and 50 *l.* 10 *oz.* 10 *p. w.* 12 *gr.* and 42 *l.* 08 *oz.* 05 *p. w.* 16 *gr.* and in order to the Addition thereof, I place them as you ſee, and proceed to operation; ſaying 16 and 12 are 28, and 18 are 46; now becauſe 24 *grains* make

l.	oz.	p.w.	gr.
38	07	13	18
50	10	10	12
42	08	05	16
132	02	09	22

1 *penny-weight*, 46 *grains* are 1 *penny-weight* and 22 *grains*; wherefore I ſet down 22, and carry 1 for the *penny-weight*, and going on I ſay, 1 that I carry and 5 make 6, and 10 are 16, and 13 are 29, which is one ounce and 9 penny-weight, I ſet down 9 in its place under the line, and carry 1 to the ounces, ſaying, 1 that I carry and 8 are 9, and 10 are 19, and 7 are 26, and becauſe 26 ounces make 2 pounds 2 ounces, I ſet down 2 for the ounces, and carry 2 to the pounds: going on, 2 that I carry and 2 are 4, and 8 make 12, that is 2 and go 1; then 1 I carry and 4 are 5, and 5 are 10, and 3 are 13, which I ſet down as in the Margent, and the work is finiſhed, and I find the ſum of the ſaid *numbers* to amount to 132 *l.* 2 *oz.* 9 *p.w.* 22 *gr.* This is ſufficient for the underſtanding of the following Examples, or any other that ſhall come to thy view. The way of proving theſe, or any Sums in this Rule, is ſhewed immediately after the enſuing Examples.

Addition of English Money.

l.	s.	d.	qrs.
436	12	07	1
184	00	10	3
768	17	04	2
564	11	11	0
1954	02	09	2

l.	s.	d.	qrs.
48	15	11	1
76	10	07	3
18	00	05	3
24	19	09	2
168	06	10	1

Addition of Troy-weight.

l.	oz.	p.w.	gr,
15	07	13	12
18	06	04	20
11	20	16	18
09	04	10	22
19	11	11	04
22	00	00	00
97	04	17	04

l.	oz.	p.w.	gr.
145	09	12	18
726	08	14	10
380	07	06	13
83	10	16	20
130	00	10	12
74	07	15	00
1541	08	16	01

Addition of Apothecaries Weights.

l.	*oz.*	*dr.*	*ſc.*	*gr.*
48	07	1	0	14
74	05	5	2	10
64	10	7	1	16
17	08	1	0	11
34	09	6	1	09
240	05	6	1	00

l.	*oz.*	*dr.*	*ſc.*	*gr.*
60	03	4	0	10
48	10	6	0	34
34	08	2	1	15
18	11	2	2	11
160	07	1	2	15
35	02	5	1	07
358	07	7	0	12

Addition of Averduqois-weight.

Tun	*C.*	*qrs.*	*l.*
75	13	1	15
48	07	3	21
60	11	1	17
21	07	0	25
12	16	0	11
218	16	0	05

l.	*oun.*	*dr.*
36	10	12
22	11	13
11	07	04
15	04	10
20	00	09
106	03	00

Addition of Liquid Meaſure.

un	*pipe*	*hhd*	*gal.*
45	1	1	48
15	0	1	17
38	0	0	47
12	1	0	56
21	1	1	18
33	1	1	60

Tuns	*hhd*	*gall.*	*pts*
30	3	40	4
12	0	28	6
47	5	60	5
57	3	22	3
17	0	00	0
166	1	26	2

Addition of Dry-Meaſure.

Chald.	*qrs.*	*buſh.*	*pec.*
48	3	7	3
13	1	4	0
54	0	6	2
16	3	6	1
40	1	0	1
173	3	0	3

qrs.	*buſh.*	*pec.*	*gall.*
17	3	1	1
50	1	3	0
14	5	3	1
40	2	0	1
30	0	3	0
152	5	3	1

Addition of Long-Meaſure.

yards	*qrs.*	*na.*
35	3	3
14	1	2
74	2	3
38	0	1
30	1	0
15	0	0
208	1	1

ells	*qrs.*	*na.*
56	1	3
13	3	2
48	2	1
50	1	0
74	0	2
17	1	0
260	2	0

Addition of Land-Meaſure.

Acre	*rood*	*perc.*
12	3	18
14	0	24
30	2	19
48	3	30
28	1	38
50	3	26
185	3	35

Acre	*rood*	*perc.*
86	1	36
47	3	24
73	2	18
60	0	07
64	2	08
14	1	14
286	3	27

The Proof of Addition.

6. *Addition* is proved after this manner, when you have found out the ſum of the Numbers given, then ſeparate the uppermoſt line from the reſt, with a ſtroke or daſh of the pen, and then add them all up again as you did before, leaving out the uppermoſt line, and having ſo done add this new invented ſum to the uppermoſt line you ſeparated, and if the ſum of thoſe two lines be equal to the ſum firſt found out, then the work was performed true, otherwiſe not. As for Example, Let us prove the firſt Example of Addition of Money, whoſe ſum we found to be 265 *l.* 9 *s.* 5 *d.* 2 *qrs.* and which we prove thus, having ſeparated the uppermoſt number from the reſt, by a line as you ſee in the Margent, then I add the ſame together again, leaving out the ſaid uppermoſt line, and the ſum thereof I ſet under the firſt ſum or true ſum, which doth amount to 128 *l.* 16 *s.* 01 *d.* 0 *qrs.* then again I add this new ſum to the uppermoſt line that before was ſeparated from the reſt, and the ſum of theſe two is 265 *l.* 09 *s.* 05 *d.* 2 *qrs.* the ſame with the firſt ſum, and therefore I conclude that the Operation was rightly performed.

l.	*s.*	*d.*	*qrs.*
136	13	04	2
79	07	10	3
33	18	09	1
15	09	05	0
265	09	05	2
128	16	01	0
265	09	05	2

7. The main end of *Addition* in Queſtions Reſolvable thereby, is to know the ſum of ſeveral Debts, Parcels, Integers, *&c.* Some Queſtions may be theſe that follow.

Queſt. 1. There was an Old Man whoſe Age was required, to which he replied, I have ſeven Sons, each having two years between the birth of each other, and in the 44th year of my Age my eldeſt Son was born, which is now the Age of my youngeſt; I demand what was the Old Man's Age?

Now to reſolve this Queſtion, firſt ſet down the Father's Age at the birth of his firſt Child, which was 44, then the difference between the eldeſt and the youngeſt, which is 12 years, and then the Age of the youngeſt which is 44, and then and them all together, and their ſum is 100 the compleat Age of the Father.

44
12
44
——
100

Queſt. 2. A Man lent his Friend, at ſeveral times, theſe ſeveral Sums; (*viz.*) at one time 63 *l.* at another time 50 *l.* at another time 48 *l.* at another time 156 *l.* now I deſire to know how much was lent him in all.

Set the Sums lent, one under another, as you ſee in the Margent, and then add them together, and you will find their Sum to amount to 317 *l.* which is the Total of all the ſeveral Sums lent, and ſo much is due to the Creditor.

l.
63
50
48
156
——
317

Queſt. 3. From *London* to *Ware* is 20 miles, thence to *Huntington* 29 miles, thence to *Stamford* 21 miles, thence to *Tuxford* 36 miles, thence to *Wentbridge* 25 miles, from thence to *York* 20 miles. Now I deſire to know how many miles it is from *London* to *York* according to this reckoning.

Now to anſwer to this Queſtion, ſet down the ſeveral diſtances given. as you ſee in the Margent, and add them together, and you will find their Sum to amount to 151, which is the true diſtance in miles between *London* and *York*.

20
29
21
36
25
20
——
151

Queſt. 4. There are two Numbers, the leaſt whereof is 40, and their difference is 14. I deſire to know what is the greater Number, and alſo what is the Sum of them both? Firſt, ſet down the leaſt, *viz.* 40, and 14 the difference, and add them together, and their Sum is 54 for the greateſt Number, then I

40
14
——

greateſt	54
leaſt	40
Sum	94

ſet 40 (the leaſt) under 54 (the greateſt) and add them together, and their ſum is 94 equal to the greateſt and leaſt *numbers.*

CHAP. V.

Of Subſtraction of Whole Numbers.

1. SUbtraction is the taking of a leſſer *Number* out of a greater of like kind, whereby to find out a third *Number*, being or declaring the inequality, exceſs, or difference between the *numbers* given; or *Subtraction* is that by which one *number* is taken out of another *number* given, to the end that the reſidue or Remainder may be known, which Remainder is alſo called the *Reſt*, *Remainder*, or *Difference* of the *numbers* given.

2. The *number* out of which *Subtraction* is to be made, muſt be greater, or at leaſt equal with the other *number* given; the higher or ſuperiour *number* is called the major *number*, and the lower or inferiour is called the minor *number*; aud the Operation of *Subtraction* being finiſhed, the Reſt or Remainder is called the Difference of the *Numbers* given.

3. In *Subtraction* place the *Numbers* given reſpectively, the one under the other, in ſuch ſort as like degrees, places or denominations, may ſtand in the ſame Series, *viz.* Units under Units, Tens under Tens, *&c.* Pounds under Pounds, *&c.* Feet under Feet, and Parts under Parts, *&c.* This being done, draw a line underneath, as in *Addition.*

4. Having placed the *Numbers* given as is before directed, and drawn the line under them, ſubtract the lower *number* (which in this caſe muſt always be leſs than the uppermoſt) out of the higher *number*, and ſubſcribe the difference or remainder reſpectively below the line; and when the Work is finiſhed, the

number below the line will give you the remainder: As for Example, let 364521 be given to be ſubtracted from 795836, I ſet the leſſer under the greater as in the Margent, and draw a line under them, then beginning at the Right-hand, I ſay, 1 out of 6 and there remains 5, which I ſet in order under the line; then I proceed to the next, ſaying, 2 from 3 reſts 1, which I note alſo under the line, and thus I go on until I have finiſhed the work, and then I find the Remainder or Difference to be 431315.

795836
364521
————
431315

5. But if it ſo happen (as commonly it doth) that the lowermoſt number or figure is greater than the uppermoſt; then in this caſe add ten to the uppermoſt number, and ſubtract the ſaid lowermoſt number from their Sum, and the remainder place under the line, and when you go to the next Figure below, pay an Unit by adding it thereto for the ten you borrowed before, and ſubtract that from the higher number or figure: And thus go on until your Subtraction be finiſhed. As for Example; Let 437503 be given, from whence it is required to ſubtract 153827, I diſpoſe of the numbers as is before directed, and as you ſee in the Margent; then I begin, ſaying, 7 from 3 I cannot, but (adding 10 thereto I ſay) 7 from 13 and there remains 6, which I ſet under the Line in order; then I proceed to the next Figure, ſaying, 1 that I borrowed and 2 is 3 from 0 I cannot, but 3 from 10 and there remains 7, which I likewiſe ſet down as before; then 1 that I borrowed and 8 is 9 from 5 I cannot, but 9 from 15 and there remains 6; then 1 I borrowed and 3 is 4 from 7 and there remains 3; then 5 from 3 I cannot, but 5 from 13 and there remains 8; then 1 I borrowed and 1 are 2 from 4 and there reſts 2; and thus the Work is finiſhed: And after theſe numbers are ſubtracted one from another, the Inequality, Remainder, Exceſs or Difference, is found to be 283676

437503
153827
————
283676
————

283676. Examples for thy further Experience may be theſe that follow.

From	3475016	From	3615746
Take	738642	Take	5864
Reſts	2736374	Reſts	3609882

6. If the *Sum* or *Numbers* to be ſubtracted, are of ſeveral Denominations, place the leſſer ſum below the greater, and in the ſame rank and order as is ſhewed in *Addition* of the ſame Numbers; then begin at the Right-hand and take the lower *Number* out of the uppermoſt if it be leſſer; but if it be bigger than the uppermoſt, then borrow an Unit from the next greater Denomination, and turn it into the Parts of the leſs Denomination, and add thoſe parts to the uppermoſt Number, and from their ſum ſubtract the lowermoſt, noting the remainder below the Line; then proceed and pay 1 to the next Denomination for that which you borrowed before, and proceed in this order until the work be finiſhed. An Example of this Rule may be this that followeth; Let 375 *l.* 13 *s.* 07 *d.* 1 *qr.* be given, from whence let it be required to ſubtract 57 *l.* 16 *s.* 03 *d.* 2 *qrs.* In order whereunto I place the Numbers as you ſee in the Margent, and thus I begin at the leaſt Denomination, ſaying, two from one I cannot, therefore I borrow one penny from the next Denomination, and turn it into farthings, which is 4, and adding 4 to 1 which is 5, I ſay, but 2 from 5 and there remains 3, which I put under the line; then going on, I ſay, 1 that I borrowed and 3 is 4 from 7 and there reſts 3; then going on, I ſay, 16 from 13 I cannot, (but borrowing one pound and turning it into 20 ſhillings, I add it to 13, and that is 33) wherefore I ſay, ſixteen from 33, and there remains 17, which I ſet under the Line and go on, ſaying, 1 that I borrowed and 7 is 8 from 5 I cannot, but 8 from 15 and there remains 7; the one that I bor-

l.	*s.*	*d.*	*qrs.*
375	13	07	1
57	16	03	2
317	17	03	3

borrowed and 5 is 6 from 7 there reſts 1, and 0 from 3 reſts 3, and the Work is done : And I find the remainder or difference to be 317 *l.* 17 *s.* 03*d.* 2 *qrs.*

Another Example of *Troy-weight* may be this, I would ſubtract 17 *l.* 10 *oz.* 11 *p.w.* 20 *gr.* from 24 *l.* 05 *oz.* 00 *p.w.* 08 *gr.* I place the Numbers according to the Rule, and begin, ſaying, 20 from 8 I cannot, but borrow 1 *Penny-weight*, which is 24 *Grains*, and add them to 8, and they are 32, wherefore I ſay, 20 from 32 reſt 12; then 1 that I borrowed and 11 is 12 from 00 I cannot, but 12 from 20 (borrowing an Ounce which is 20 *Penny-weight*) and there remains 8, then 1 that I borrowed and 10 is 11 from 5 I cannot, but 11 from 17 and there reſts 6; then 1 that I borrowed and 7 is 8 from 4 I cannot, but 8 from 14 and there reſts 6; then 1 that I borrowed and 1 is 2 from 2 and there reſts nothing; ſo that I find the remainder or difference to be 6 *l.* 6 *oz.* 8 *p.w.* 12 *gr.*

l.	*oz.*	*p.w.*	*gr.*
24	05	00	08
17	10	11	20
06	06	08	12

7. It many times happeneth that you have many *Sums* or *Numbers* to be *ſubtracted* from one *Number* ; as ſuppoſe a Man ſhould lend his Friend a certain ſum of Money, and his Friend hath paid him part of his Debt at ſeveral times, then before you can conveniently know what is ſtill owing, you are to add the ſeveral *Numbers* or *Sums* of Payment together, and *ſubtract* their *Sum* from the whole Debt, and the remainder is the *Sum* due to the Creditor : As ſuppoſe A lendeth to B 564 *l.* 13 *s* 10 *d.* and B hath repaid him 79 *l.* 16 *s.* 8 *d.* at one time, and 163 *l.* 18 *s.* 11 *d.* at another time, and 241 *l.* 15 *s.* 08 *d.* at another time; and you would know how the *Accompt* ſtandeth between them, or what is more due to A. In order whereunto

	l.	*s.*	*d.*
Lent	564	13	10
Paid at ſeveral Payments	79	16	08
	163	18	11
	241	15	08
Paid in all	485	11	03
Remains	79	02	07

I firſt ſet down the *Sum* which A lent, and draw a line underneath it; then under that line ſet the ſeveral *Sums* of Payment as you ſee in the Margent; and having brought the ſeveral Sums of Payment into one total by the fifth Rule of the fourth Chapter foregoing, I find their Sum amounteth to 485 *l.* 11 *s.* 3 *d.* which I ſuſtract from the Sum firſt lent by A, by the ſixth Rule of this Chapter, and I find the remainder to be 79 *l.* 2 *s.* 7 *d.* and ſo much is ſtill due to A.

When the Learner hath good knowledge of what hath been already delivered in this and the foregoing Chapter: he will with eaſe underſtand the manner of working the following Examples.

Subtraction of Whole Money.

	l.	*s.*	*d.*	*l.*	*s.*	*d.*	*qrs*
Borrowed	374	10	03	700	10	11	2
Paid	69	15	11	9	03	11	3
Remains	304	14	04	691	06	11	3

	l.	*s.*	*d.*	*l.*	*s.*	*d.*	*qrs*
Borrowed	1000	00	00	711	03	00	0
Paid	19	00	06	11	13	00	1
Remains	980	19	06	699	09	11	3

	l.	*s.*	*d.*	*qrs.*
Borrowed	3300	00	00	0
Paid at ſeveral Payments.	170	10	00	0
	361	13	10	1
	590	03	04	3
	73	04	11	3
Paid in all	1195	12	01	3
Remains due	2104	07	09	6

Subtraction of Troy-weight.

	l.	oz.	p.w.	gr.
Bought	174	00	13	00
Sold	78	04	16	15
Remains	95	07	16	09

	l.	oz.	p.w.	gr.
Bought	470	10	13	00
Sold at ſeveral Times	60	00	00	00
	35	10	18	00
	16	07	09	08
	48	04	00	00
	61	11	19	23
	23	00	00	00
Sold in all	245	10	07	07
Remains unſold	225	00	05	17

Subtraction of Apothecaries Weights.

	l.	oz.	dr.	ſc.	gr.	l.	oz.	dr.	ſc.	gr.
Bought	12	04	3	0	00	20	00	1	0	07
Sold	8	05	1	1	15	10	00	1	2	12
Remains	3	11	1	1	05	9	11	7	0	15

Subtraction of Averdupois-weight.

	C.	qrs	l.	Tun	C.	qrs	l.	oz.	dr.
Bought	25	0	15	15	07	1	10	10	05
Sold	16	2	20	03	17	1	16	09	13
Remains	08	1	23	11	9	3	22	00	08

Sub-

Subtraction of Liquid Measure.

	Tuns	hhd	gall.	Tuns	hhd	gall.	pin.
Bought	40	1	30	60	3	42	4
Sold	16	1	40	15	3	46	6
Remains	23	3	53	44	3	58	6

Subtraction of Dry Measure.

	Chald.	qrs.	buſh.	pec.	Chald.	qrs.	buſh.	pec.
Bought	100	0	00	0	73	2	3	2
Sold	54	1	04	3	46	2	3	3
Remains	45	2	03	1	26	3	7	3

Subtraction of Long Meaſure.

	Yards	qrs	nails	Yards	qrs	nails
Bought	160	1	0	344	0	1
Sold	64	1	2	177	1	3
Remains	95	3	2	166	2	2

Subtraction of Land Meaſure.

	Acres	roods	perc.	Acres	roods	perc.
Bought	140	2	13	600	0	00
Sold	70	3	22	54	0	16
Remains	69	2	31	545	3	24

The Proof of Subtraction.

8. When your Subtraction is ended, if you deſire

to prove your work, whether it be true or no, then add the remainders to the minor Number, and if the Aggregate of theſe two be equal to the major number, then is your Operation true, otherwiſe falſe; thus let us prove the firſt Example of the fifth Rule of this Chapter, where after Subtraction is ended, the Numbers ſtand as in the Margent; the remainder or difference being 283676. Now to prove the Work, I add the ſaid Remainder 283676 to the minor Number 153827, by the fourth Rule of the foregoing Chapter, and I find the Sum or Aggregate to be 437503 equal to the major Number, or Number from whence the leſſer is ſubtracted. Behold the Work in the Margent.

437503
153827
———
283676
———
437503

The Proof of another Example may be of the firſt Example of the ſixth Rule of this Chapter, where it is required to ſubtract 57 *l.* 16 *s.* 03 *d.* 2 *qrs* from 375 *l.* 13 *s.* 07 *d.* 1 *qr.* and by the *Rule* I find the Remainder to be 317 *l.* 17 *s.* 03 *d.* 3 *qrs.* now to prove it, I add the ſaid Remainder 317 *l.* 17 *s.* 03 *d.* 3 *qrs.* to the minor Number 57 *l.* 16 *s.* 03 *d.* 2 *qrs.* and their Sum is 375 *l.* 13 *s.* 07 *d.* 1 *qr.* equal to the major Number, which proves the Work to be true; but if it had happened to have been either more or leſs than the ſaid major Number, then the Operation had been falſe.

l.	*s.*	*d.*	*qrs*
375	13	07	1
57	16	03	3
317	17	03	2
375	13	07	1

9. The general effect of *Subtraction*, is to find the difference or exceſs between two Numbers, and the reſt when a Payment is made in part of a greater Sum, the date of Books printed, the age of any thing by knowing the preſent year, and the year wherein they were made, created, or built, and ſuch like.

The Queſtions appropriated to this Rule are ſuch as follow.

Queſt. 1. What difference is there between one thing of 125 foot long and another of 66 foot long?

To reſolve this Queſtion, I firſt ſet down the major or greater number 125, and under it the minor or leſſer number 66, as is directed in the third *Rule* of this Chapter, and according to the fourth *Rule* of the ſame, I ſubtract the minor from the major, and the Remainder, Exceſs or Difference I find to be 59. See the Work in the Margent.

125
66

59

Queſt. 2. A Gentleman oweth a Merchant 365 *l.* whereof he hath paid 278 *l.* what more doth he owe?

To give an *Anſwer* to this *Queſtion*, I firſt ſet down the major number 365 *l.* and under it I place 278 the minor, and ſubtract the one from the other, and thereby I diſcover the Exceſs, Difference or Remainder to be 87, and ſo much is ſtill due to the Creditor, as *per* Margent.

365
278

87

Queſt. 3. An Obligation was written, a Book printed, a Child born, a Church built, or any other thing, made in the Year of our Lord 1575, and now we account the Year of our Lord 1701, the Queſtion is to know the Age of the ſaid things, that is, how many Years are paſſed ſince the ſaid things were made? I ſay, if you ſubtract the leſſer number 1572, from the greater 1705, the remainder will be 133, and ſo many Years are paſt ſince the making of the ſaid things; as by the Work in the Margent.

1705
1572

133

Queſt. 4. There are three Towns lie in a ſtreight line, *viz.* *London*, *Huntingdon*, and *York*, now the diſtance between the fartheſt of theſe Towns, *viz.* *London* and *York* is 151 miles, and from *London* to *Huntington* is 49 miles, I demand how far it is from *Huntington* to *York*.

To reſolve this Queſtion, ſubtract 49 the diſtance between *London* and *Huntington*, from 151 the diſtance between *London* and *York*, and the Remainder is 102, for the true diſtance between *Huntington* and *York*. See the work in the Margent.

151
49
—
102
—

CHAP. VI.

Of Multiplication of Whole Numbers.

1. *Multiplication* is performed by two Numbers of like kind for the production of a third, which ſhall have ſuch reaſon to the one, as the other hath to a Unit, and in effect is a moſt brief and artificial compound *Addition* of many equal Numbers of like kind into one ſum. Or *Multiplication* is that by which we multiply two or more Numbers, the one into the other, to the end that their Product may come forth, or be diſcovered.

Or, *Multiplication* is the increaſing of any one number by another; ſo often as there are Units in that Number, by which the other is increaſed, or by having two Numbers given to find a third, which ſhall contain one of the Numbers as many times as there are Units in the other.

2. *Multiplication* hath three parts, Firſt, the *Multiplicand* or Number to be *Multiplied*. Secondly, the *Multiplier*, or Number given, by which the *Multiplicand* is to be *Multiplied*. And Thirdly, the *Product* or Number produced by the other two, the one being multiplied by the other, as if 8 were given to be Multiplied by 4, I ſay 4 times 8 is 32, here 8 is the *Multiplicand*, and 4 is the *Multiplier*, and 32 is the *Product*.

8
4
—
32

3. *Multiplication* is either ſingle by one Figure; or compound, that conſiſts of many.

Single Multiplication is ſaid to conſiſt of one figure, becauſe the Multiplicand and Multiplier conſiſt each of them of a Digit, and no more, ſo that the greateſt Product that can ariſe by ſingle ***Multiplication*** is 81, being the ſquare of 9; and Compound Multiplication is ſaid to conſiſt of many Figures, becauſe the Multiplicand or Multiplier conſiſts of more places than one; as if I were to multiply 436 by 6, it is called Compound, becauſe the Multiplicand 436 is of more places than one, (*viz.*) 3 places.

4. The Learner ought to have all the varieties of ſingle Multiplication by heart before he can well proceed any further in this Art, it being of moſt Excellent Uſe, and none of the following Rules in Arithmetick but what have their principal dependance thereupon, which may be learnt by the following Table.

Multiplication Table.

1	2	3	4	5	6	7	8	9
2	4	6	8	10	12	14	16	18
3	6	9	12	15	18	21	24	27
4	8	12	16	20	24	28	32	36
5	10	15	20	25	30	35	40	45
6	12	18	24	30	36	42	48	54
7	14	21	28	35	42	49	56	63
8	16	24	32	40	48	56	64	72
9	18	27	36	45	54	63	72	81

The uſe of the precedent Table is this. In the uppermoſt Line or Column you have expreſſed all the Digits from 1 to 9; and likewiſe beginning at 1 and going downwards in the ſide Column you have the ſame; ſo that if you would know the Product of any two ſingle Numbers multiplied by one another, look for one of them (which you pleaſe) in the uppermoſt Column, and for the other in the ſide Column, and running your eye from each figure along the reſpective Column, in the common Angle (or place) where theſe two Columns meet, there is the product required. As for Example, I would know how much is 8 times 7; Firſt, I look for 8 in the uppermoſt Column, and 7 in the ſide Column; then do I caſt my eye from 8 along the Column downwards from the ſame, and likewiſe from 7 in the ſide Column, I caſt my eye from thence towards the Right-hand, and find it to meet with the firſt Column at 56, ſo that I conclude 56 to be the Product required; it would have been the ſame if you had looked for 7 in the top, and 8 on the ſide, the like is to be underſtood of any other ſuch Numbers. The Learner being perfect herein, it will be neceſſary to proceed.

5. In Compound *Multiplication*, if the *Multiplicand* conſiſts of many places, and the *Multiplier* of but one Figure; firſt ſet down the *Multiplicand*, and under it place the *Multiplier* in the place of Units, and draw a Line underneath them; then begin and multiply the *Multiplier* into every particular Figure of the *Multiplicand*, beginning at the place of Units, and ſo proceed towards the Left-hand, ſetting each particular Product under the Line, in order as you proceed; but if any of the Product exceed 10 or any number of Tens, ſet down the Exceſs, and for every 10 carry a Unit to be added to the next Product, always remembring to ſet down the total Product of the laſt Figure; which Work being finiſhed, the Sum or Number placed under the Line ſhall be the true and Total Product required. As for Example, I would multiply 478 by 6, firſt I ſet down 478, and underneath it 6 in the place of Units, and draw a Line underneath them, as in the Margent; then I begin, ſaying, 6 times 8 is 48, which is 8 above 4 Tens, therefore I ſet down 8 (the Exceſs) and

```
 478
   6
————
2868
```

bear 4 in mind for the 4 tens; then I proceed, ſaying, 6 times 7 is 42 and 4 that I carried is 46, I then ſet down 6 and carry 4, and go on, ſaying 6 times 4 is 24, and 4 that I carried is 28, and becauſe it is the laſt figure, I ſet it all down, and ſo the work is finiſhed, and the product is found to be 2868, as was required.

6. When in compound *Multiplication*, the multiplier conſiſteth of divers places, then begin with the figure in the place of Units in the Multiplier, and Multiply it into all the figures in the Multiplicand, placing the product below the line as was directed in the laſt Example; then begin with the figure of the ſecond place of the multiplier, (*viz.*) the place of Tens, and multiply it likewiſe into the whole multiplicand (as you did the firſt figure) placing its product under the product of the firſt figure; do in the ſame manner by the third, fourth and fifth, *&c.* until you have multiplied all the figures of the multiplier particularly into the whole multiplicand, ſtill placing the product of each particular figure under the product of its precedent figure; herein obſerving the following Caution.

A Caution. In the placing of the product of each particular figure of the multiplier, you are not to follow the 2*d* Rule of the 4th Chapter, *viz.* not to place Units under Units, and Tens under Tens, *&c.* but to put the Figure or Cypher in the place of Units of the ſecond line under the ſecond figure or place of the Tens in the line above it, and the figure or Cypher in the place of Units of the third line under the place of Tens in the ſecond line, *&c.* Obſerving this order till you have finiſhed the Work, *viz.* ſtill placing the firſt figure of every line or product under the ſecond figure or place of Tens in that which was above it, and having ſo done, draw a line under all theſe particular products, and add them together; ſo ſhall the ſum of all theſe products be the total product required.

As if it were required to multiply 764 by 27, I ſet them down the one under the other, with a line drawn underneath them; then I begin, ſaying, 7 times 4 is 28, then I ſet down 8, and carry 2, then I ſay 7 times 6 is 42, and 2 that I carried is 44, that is 4 and go 4; then 7 times 7 is 49, and 4 that I carry is 53, which I ſet down becauſe I have not another Figure to multiply; thus have I done with the 7, then I begin with the 2, ſaying, 2 times 4 is 8, which I ſet down under (4) the ſecond Figure or place of Tens in the Line above it, as you may ſee in the Margent: Then I proceed, ſaying, 2 times 6 is 12, that is two and carry one, then 2 times 7 is 14, and 1 that I carry is 15, which I ſet down becauſe 'tis the product of the laſt Figure; ſo that the product of 764 by 27 is 5348, and by 2 is 1528, which being placed the one under the other, as is before directed, and as you ſee in the Margent, and a Line drawn under them, and they added together reſpectively, make 20628 the true product required, being equal to 27 times 764.

$$\begin{array}{r} 764 \\ 27 \\ \hline 5348 \\ 1528 \\ \hline 20628 \end{array}$$

Another Example may be this; Let it be required to multiply 5486 by 465. I diſpoſe of the Multiplicand and Multiplier, according to the Rule, and begin multiplying the firſt figure of the Multiplier, which is (5) into the whole Multiplicand, and the product is 27430; then I proceed and multiply the ſecond figure (6) of the Multiplier into the Multiplicand, and find the Product to amount to 32916, which is ſubſcribed under the other Product reſpectively, then do I multiply the third and laſt figure (4) of the Multiplier into the Multiplicand, and the Product is 21944. which is likewiſe placed under the ſecond Line reſpectively; then I draw a Line under the ſaid Products (being placed the one under the other according to this Rule) and add them together, and the ſum is 2550990, the true Product ſought, being equal to 5486 times 465, or 465 times 5486.

$$\begin{array}{r} 5486 \\ 465 \\ \hline 27430 \\ 32916 \\ 21944 \\ \hline 2550990 \\ \hline \end{array}$$

More Examples in this Rule are theſe following.

```
   430865
     4739
---------
  3877785
 1292595
3016055
1723460
---------
2041869235
```

```
     6400758
       37496
------------
    38404548
   57606822
  25603032
 44805306
19202274
------------
240002821968
```

Compendiums in Multiplication.

7. Although the former Rules are ſufficient for all Caſes in *Multiplication*, yet becauſe in the work of *Multiplication* many times great labour may be ſaved, I ſhall acquaint the Learner with ſome Compendiums in order thereto, *viz.* If the *Multiplicand* or *Multiplier*, or both of them end with Cyphers, then in your multiplying you may neglect the Cyphers, and multiply only the ſignificant Figures, and to the Product of thoſe ſignificant Figures, add ſo many Cyphers as the Numbers given to be multiplied did end with; that is, annex them on the Right-hand of the ſaid Product, ſo ſhall that give you the true Product required. As if I were to multiply 32000 by 4300, I ſet them down in order to be multiplied as you ſee in the Margent, but neglecting the Cyphers in both numbers, I only multiply 32 by 43, and the Product I find to be 1376, to which I annex the 5 Cyphers that are in the Multiplicand and Multiplier, and then it makes 137600000 for the true Product of 32000 by 4300.

Si e numeris propoſitis unus vel uterque adjunctos habeat ad dextram circulos; omiſſis circulis fiat ipſorum numerorum multiplicatio, & facto demum tot inſuper integrorum loci accenſeantur quot ſunt omiſſi circuli in utroque factore, Clavis Mat. c. 4. 3.

```
    32000
    4300
---------
    96
   128
---------
137600000
```

8. If in the Multiplier, Cyphers are placed beteween ſignificant figures, then multiply only by the ſignificant Figures, neglecting the Cyphers, but here ſpecial notice is to be taken of the true placing of the firſt figure after the neglect of ſuch Cypher or Cyphers; and therefore you muſt obſerve in what place of the multiplier the figure you multiply by ſtandeth, and ſet the firſt figure of that product under the ſame place of the product of the firſt figure of your multiplier: As for Example, let it be required to multiply 371568 by 40007, firſt I multiply the multiplicand by 7, and the product is 2600976, then neglecting the Cyphers I multiply by 4, and that product is 1486272; now I conſider that 4 is the fifth figure in the multiplier, therefore I place two (the firſt figure of the product by 4) under the fifth place of the firſt product by 7, and the reſt in order, and having added them together, the total product is found to be 14865320976. Other Examples in this Rule are theſe following;

Si intermedio multiplicantis loco circulus fuerit, ille negligetur Alſted. cap. 9. de Arithm.

371568
40007
2600976
1486272
14865320976

327586
6030
9827520
1965516
1975343580

7864371
20604
31457484
47186226
15728742
162037500084

9. If you are to multiply any Number by an Unit with Cyphers, (*viz.*) by 10, 100, 1000, *&c.* then annex ſo many Cyphers before the Multiplicand, and that number when the Cyphers are annexed is the product required; as if you would multiply 428 by 100, annex two Cyphers to 428 and it is 42800: If it were

required to multiply 102 by 10000, annex 4 Cyphers and it gives 1020000 for the Product required.

The Proof of Multiplication.

10. *Multiplication* is proved by *Diviſion*, and to ſpeak truth all other ways are falſe; and therefore it will be moſt convenient in the firſt place to learn Diviſion, and by that to prove Multiplication. There is a Way (at this Day generally uſed in Schools) to prove Multiplication, which is this, firſt add all the Figures in the Multiplicand together, as if they were ſimple Numbers, caſting away the Nines as often as it comes to ſo much, and noting the remainder at laſt, which in this caſe cannot be ſo much as 9: Caſt likewiſe the Nines out of the Multiplier as you did out of the Multiplicand, and note that remainder; then Multiply the Remainders, the one by the other, and caſt the Nines out of the Product, obſerving the Remainder; and laſtly, caſt the Nines out of the total Product, and if this Remainder be equal to the Remainder laſt found, then they conclude the Work to be rightly performed; but there may be given a thouſand (nay infinite) falſe Products in Multiplication, which after this manner may be proved to be true, and therefore this way of proving doth not deſerve any Example; but we ſhall defer the proof of this Rule till we come to prove Diviſion, and then we ſhall prove them both together.

Non eſt quod aliam expectes examinandi viam; nam aliæ vulgares, & falſæ ſunt, & nullo innixa fundamento.
Gemma Friſius.

11. The general effect of *Multiplication* is contained in the definition of the ſame, which is to find out a third number, ſo often containing one of the two given Numbers, as the other containeth Units.

The ſecond effect is by having the length and breadth of any thing (as a Parallelogram, or long Plane) to find the ſuperficial Content of the ſame, and by having the ſuperficial Content of the Baſe, and the length to find out the ſolidity of any Parallelipipedon, Cylinder, or other ſolid Figures.

The third Effect is by the Contents, Price, Value Buying, Selling, Expence, Wages, Exchange, ſimpl Intereſt, Gain or Loſs of any one thing, be it Money Merchandize, *&c.* to find out the Value, Price, Expence, Buying, Selling, Exchange, or Intereſt of an number of things of like Name, Nature and Kind.

The fourth Effect is (not much unlike the other) by the Contents, Value, or Price of one part of any thing denominated, to find out the Content, Value, or Price of the whole thing, all the parts into which the whole is divided, multiplying the price of one of thoſe parts.

The fifth Effect is, to aid, to compound, and to make other Rules, as chiefly the Rule of Proportion, called the Golden Rule, or Rule of Three; alſo by it, things of one denomination are reduced to another.

If you multiply any number of Integers or the price of the Integer, the product will diſcover the price of the Quantity or Number of Integers given.

In a Rectangular Solid, if you multiply the breadth of the Baſe by the depth, and that product by the length, this laſt product will diſcover the Solidity or Content of the ſame Solid.

Some Queſtions proper to this Rule may be theſe following.

Queſt. 1. What is the Content of a ſquare piece of Ground, whoſe length is 28 *Perches*, and breadth 13 *Perches?*

Anſ. 364 ſquare *Perches*, for multiplying 28 the length by 13 the breadth, the product is ſo much.

Queſt. 2. There is a ſquare Battel whoſe Flank is 47 Men, and the Files 19 deep, what number of Men doth that Battle contain? *Facit* 893; for multiplying 47 by 19, the product is 893.

Queſt. 3. If any one thing coſt 4 ſhillings, what ſhall 9 ſuch things coſt? *Anſw.* 36 ſhillings; for multiplying 4 by 9, the product is 36.

Queſt. 4. If a piece of Money or Merchandize be worth or coſt 17 ſhillings, what ſhall 19 ſuch pieces of Money or Merchandize coſt? *Facit* 323 ſhillings, which is equal to 16 *l.* 3 *s.*

Queſt. 5. If a Soldier or Servant get or ſpend 14 *s.* *per* Month, what is the Wages or Charges of 49 Soldiers or Servants for the ſame time? Multiply 49 by 14, the Product is 686 *s.* or 34 *l.* 6 *s.* for the *Anſwer.*

Queſt. 6. If in a day there are 24 hours, how many hours are there in a year, accounting 365 days to conſtitute the year? *Facit* 8760 hours; to which if you add the 6 hours over and above 365 days, as there is in a year, then it will be 8766 hours; now if you multiply this 8766 by 60, the number of minutes in an hour, it will produce 525960 for the number of minutes in a year.

CHAP. VII.

Of Diviſion of Whole Numbers.

1. DIVISION is the ſeparating or parting of any Number or Quantity given into any parts aſſigned; or to find how often one Number is contained in another: or from any two Numbers given to find a third that ſhall conſiſt of ſo many Units, as the one of thoſe two given Numbers is comprehended or contained in the other.

2. *Diviſion* hath three Parts or Numbers remarkable, *viz.* Firſt, the *Dividend.* Secondly, the *Diviſor.* Thirdly, the *Quotient.* The *Dividend* is the Number given to be parted or divided. The *Diviſor* is the Number given, by which the *Dividend* is divided: Or it is the Number which ſheweth how many parts the *Dividend* is to be divided into: and the *Quotient* is the Number produced by the *Diviſion* of the two given Numbers, the one by the other.

So 12 being given to be divided by 3, or into three equal parts, the *Quotient* will be 4, for 3 is contained in 12 four times, where 12 is the *Dividend*, and 3 is the *Diviſor*, and 4 is the *Quotient.*

3. In *Diviſion* ſet down your dividend, and draw a crooked line at each end of it, and before the line at the left-hand, place the diviſor, and behind that on the right-hand, place the Figures of the quotient, as in the Margent, where it is required to divide 12 by 3: Firſt, I ſet down 12 the dividend, aud on each ſide of it do I draw a crooked line, and before that on the left hand do I place 3 the diviſor; then do I ſeek how often 3 is contained in 12, and becauſe I find it 4 times, I put 4 behind the crooked line on the right-hand of the dividend, denoting the quotient.

3) 12 (4

4. But if when the diviſor is a ſingle Figure, the dividend conſiſteth of two or more places, then (having placed them for the Work as is before directed) put a point under the firſt figure on the left hand of the dividend, provided it be bigger than (or equal to) the diviſor, but if it be leſſer than the diviſor, then put a point under the ſecond figure from the lelft hand of the dividend, which figures as far as the point goeth from the left hand are to be reckoned by themſelves, as if they had no dependance upon the other part of the dividend, and for diſtinction ſake may be called the dividual; then ask how often the diviſor is contained in the dividual, placing the Anſwer in the quotient; then multiply the diviſor by the figure that you placed in the quotient, and ſet the product thereof under the dividual; then draw a line under that product, and ſubtract the ſaid product from the dividual, placing the remainder under the ſaid line, then put a point under the next figure in the dividend on the right hand of that which you put the point before, and draw it down, placing it on the right-hand of the remainder, which you found by Subtraction; which remainder with the ſaid figure annexed before it, ſhall be a new dividual; then ſeek again how often the diviſor is contained in this new dividual; and put the Anſwer in the qnotient on the right-hand of the figure which you put there before, then multiply the diviſor by the laſt figure that you

put in the Quotient, and ſubſcribe the product under the dividual, and make Subtraction, and to the remainder draw down the next Figure from the grand dividend, having firſt put a point under it, and put it on the Right-hand of the remainder for a new dividual as before, *&c.* and proceed thus till the Work is finiſhed.

Obſerving this general Rule in all kinds of Diviſion, firſt to ſeek how often the diviſor is contained in the dividual; then (having put the Anſwer in the Quotient) multiply the diviſor thereby, and ſubtract the product from the dividual. An Example or two will make the Rule plain. Let it be required to divide 2184 by 6. I diſpoſe of the Numbers given as is before directed, and as you ſee in the Margent, in order to the Work, then becauſe 6 the diviſor is more than 2 the firſt Figure of the dividend) I put a point under 1 the ſecond Figure, which makes the 21 for the dividual, then do I ask how often 6 the diviſor is contained in 21, and becauſe I cannot have it more than 3 times, I put 3 in the Quotient, and thereby do I multiply the diviſor (6) and the product by 18, which I ſet in order under the dividual, and ſubtract it therefrom, and the remainder (3) I place in order under the line, as you ſee in the Margent.

```
6) 2184 (3
     .
```

```
6) 2184 (3
     .
   18
   ---
    3
```

Then do I make a point under the next Figure of the dividend being 8, and draw it down placing it before the remainder 3, ſo have I 38 for a new dividual, then do I ſeek how often 6 is contained in 38, and becauſe I cannot have more than 6 times, I put 6 in the Quotient, and thereby do I multiply the diviſor 6, and the product (36) I put under the dividual (38) and ſubtract it therefrom, and the remainder 2 I put under the Line, as you ſee in the Margent.

```
6) 2184 (36
     ..
   18
   ---
    38
    36
    ---
     2
```

Then do I put a point under the next (and laſt) figure of the dividend (being 4) and draw it down to the remainder 2, and putting it on the Right-hand thereof, it maketh 24 for a new dividual; then I ſeek how often 6 is contained in 24, and the Anſwer is 4, which I put in the quotient, and multiply the diviſor (6) thereby; and the product (24) I put under the dividual (24) and ſubtract it therefrom, and the remainder is 0, and thus the Work is finiſhed, and I find the quotient to be 364, that is, 6 is contained in 2184 juſt 364 times, or 2184 being divided into 6 equal parts, 264 is one of thoſe parts.

```
6)2184(364
   ...
  18
  ---
   38
   36
   ---
    24
    24
    ---
    (0)
```

Again, if it were required to divide 2646 by 7, or into 7 equal parts, the quotient would be found to be 378, as by the following Operation appeareth.

```
7) 2646 (378
   ...
   21
   ---
    54
    49
    ---
     56
     56
     ---
     (0)
```

So if it were required to divide 946 by 8, the quotient will be found to be 118, and 2 remaining after Diviſion is ended. The Work followeth.

8) 946 (118
· · ·
8

14
8

66
64

(2)

Many times the dividend cannot exactly be divided by the diviſor, but ſomething will remain, as in the laſt Example, where 946 was given to be divided by 8, the quotient was 118 and there remaineth 2 after the Diviſion is ended: Now what is to be done in this caſe with the remainder, the Learner ſhall be taught when we come to treat of reducing (or Reduction) of Fractions.

And here note, that if after your Diviſion is ended, any thing do remain, it muſt be leſſer than your diviſor, for otherwiſe your Work is not rightly perform'd.

Other Examples are ſuch as follow.

8) 73464 (9183
· · · ·
72

14
8

66
64

24
24

(0)

9) 13758 (1528
· · · ·
9

47
45

25
18

78
72

(6)

5. But if the diviſor conſiſteth of more places tha one, then chuſe ſo many Figures from the left ſide o the dividend for a dividual as there are Figures in th diviſor, and put a point under the fartheſt Figure o that dividual to the Right-hand, and ſeek how ofte the firſt Figure on the left ſide of the diviſor, is contained in the firſt Figure on the left ſide of the dividual, and place the Anſwer in the Quotient, and thereby multiply your diviſor, placing your product unde your dividual, and ſubtract it therefrom, placing th remainder below the line; then put a point under th next Figure in the dividend, and draw it down to th ſaid remainder, and annex it on the right ſide thereof which makes a new dividual, and proceed as before till the Work is finiſhed.

And if it ſo happen that after you have choſen you firſt dividual (as is before directed) you find it to b leſſer than the diviſor, then put a point under a Figur more near to the Right-hand, and ſeek how often th firſt Figure on the left ſide of the diviſor is contained i the two firſt Figures on the left ſide of the dividual and place the anſwer in the quotient, by which multiply the diviſor, and place the product thereof in order under the dividual, and ſubtract it therefrom, an proceed as before.

Always remembring, that (in all caſes of Diviſion) if after you have multiplied your diviſor by the Figure laſt placed in the Quotient, the product be greater than the dividual, then you muſt cancel that Figure in the Quotient, and inſtead thereof put a Figure leſſer by a Unit (or one) and multiply the diviſo thereby, and if ſtill the product be greater than th dividual, make the Figure in the Quotient yet leſſer b a Unit, and thus do until your product be leſſer tha the dividual, or at the moſt equal thereto, and the make Subtraction, *&c.*

So if you would divide 9464 by 24, the quotien will be found to be 394; I firſt put down the give Numbers, as is before directed in the third Rule: No

becauſ

becauſe my diviſor conſiſteth of two Figures, I therefore put a point under the ſecond Figure from the Left-hand in My dividend, which here is 4, wherefore I ſeek how often 2 the firſt Figure (on the left ſide of the diviſor) is contained in 9 (the like firſt in the dividual) the anſwer is 4, which I put in the quotient, and thereby multiply all the diviſors, and find the product to be 96, which is greater than the dividual 94, wherefore I cancel the 4 in the quotient, and inſtead thereof I put 3 (a Unit leſſer) and by it multiply the diviſor 34, and the product is 72, which I ſubtract from 94 the dividual, and the remainder is 22, then do I make a point under the next Figure 6 in the dividend, and draw it down and place it on the right ſide of the remainder 22, and it makes 226 for a new dividual, now becauſe the dividual 226 conſiſteth of a Figure more than the diviſor, therefore I ſeek how often 2 (the firſt Figure of the diviſor is contained in 22, the two firſt of the dividual) I ſay 9 times, wherefore I put 9 in the quotient, and thereby multiply the diviſor 24, the product (216) I place under the dividual 226, and ſubtract it from it, and there remaineth 10.

```
                (3
    24) 9454 (4.
         .
        72
       ----
        22
```

```
    24) 9464 (39
         ..
        72
       ----
        226
        216
       ----
         10
```

Then I go on and make a point under the next and laſt Figure (4) in the dividend, and draw it down to the remainder 10, and it maketh 104, for a new dividual, which is alſo a Figure more than the diviſor, and therefore I ſeek how often two is contained in 10, I anſwer 5 times, but multiplying my diviſor by 5, the product is 120, which is greater than the dividual, and therefore I make it but 4, and by it multply the diviſor, and the product is 96, which being placed under, and ſubtracted from the dividual, there remaineth 8, and thus the whole Work of this Diviſion is ended, and I find that 9464 being divided by 24, or into 24 equal parts, is found to be 394, as was ſaid before, and the remainder is 8, as you ſee in the Work following.

```
24) 9464 (394
    . . .
    72
    ----
    226
    216
    ----
     104
      96
    ----
     (8)
```

Another Example may be this, let there be required the quotient of 1183653 divided by 385; firſt I diſpoſe of the Numbers in order to their dividing, and becauſe 118 the three firſt Figures of the dividend is leſſer than the diviſor 385, I therefore make a point under the fourth Figure, which is 3, and ſeek how often 3 (the firſt Figure of the diviſor) is contained in 11? The Anſwer is 3, which I put in the Quotient, and thereby multiply the diviſor 385, and the product is 1155, which I ſubtract from the dividual 1188, and there remains 28. Then (as before) I draw down the next Figure, which is 6, and place it after the remainder 28 ſo have I 286 for a new dividual, and becauſe it hath no more Figures than the diviſor, I ſeek how often 3 (the firſt Figure in the diviſor) is contained in 2 (the firſt Figure of the dividual) and the Anſwer is 0, for a greater Number cannot be contained in a leſſer, wherefore I put 0 in the quotient, and thereby (according to the 5th Rule) I ſhould multiply my diviſor, but if I do the product will be 0, and

```
385) 1183653 (3
        .
     1155
     ----
       28
```

```
385) 1183653 (30
        ..
     1155
     ----
      286
```

and 0 ſubtracted from the dividual 286, the remainder is the ſame; wherefore I draw down the next figure (5) from the dividend, and put it after the ſaid remainder 286, ſo have I 2865 for a new dividual, and becauſe it conſiſteth of four places, *viz.* a place more than the diviſor, I ſeek how often 3 (the firſt figure of the diviſor) is contained in 28 (the two firſt of the dividual) and I ſay there is 9 times 3 in 28, but multiplying my whole diviſor (385) thereby I find the product to be 3465, which is greater than the dividual 2865, wherefore I chuſe 8, which is leſſer by an Unit than 9, and thereby I multiply my diviſor 385, and the product is 3080, which ſtill is greater than the ſaid dividual, wherefore I chuſe another number yet a Unit leſſer, *viz.* 7; and having multiplied my diviſor thereby, the product is 2695, which is leſſer than the dividual 2865, wherefore I put 7 in the quotient, and ſubtract 2695 from the dividual 2865, and there remains 170; then I draw down the laſt figure (3) in the dividend, and place it after the ſaid remainder 170, and it makes 1703 for a new dividual, then (for the Reaſon aboveſaid) I ſeek how often 3 is contained in 17, the anſwer is 5, but multiplying the diviſor thereby, the product is (1925) greater than the dividual, wherefore I ſay it will bear 4 (a Unit leſſer) and by it I multiply the diviſor 385 and the product is 1540, which is leſſer than the dividual, and therefore I put 4 in the quotient, and ſubtract the ſaid product from the dividual, and there remaineth 163 and thus the Work is finiſhed, and I find that 1183653 being divided by 385, or

```
385) 1183653 (307
       ...
     1155
     ----
      2865
      2695
      ----
       170
```

```
385) 1183653 (3074
       ....
     1155
     ----
      2865
      2695
      ----
       1703
       1540
       ----
       (163)
```

or into 385 equal ſhares or parts, the Quotient (or one of thoſe parts) is 3074, and beſides there is 163 remaining.

And thus the Learner being well verſed in the Method of the foregoing Examples, he may be ſufficiently qualified for the dividing of any greater Sum or Number into as many parts as he pleaſeth, that is, he may underſtand the method of dividing by a diviſor, which conſiſteth of 4 or 5, or 6, or any greater number of places, the method being the ſame with the foregoing Examples in every reſpect.

Other Examples in Diviſion.

```
27986) 835684790 (29860
        •••••
        55972
       -------
        275964
        251874
       -------
         240907
         223888
        -------
          17019
         167916
        -------
Remains  (22830)
---------------------------------
196374) 473986018 (2413
           ••••
          392748
         -------
           812380
           785496
          -------
           268841
           196374
          -------
            724678
            589122
           -------
Remains   (135556)
```

So if you divide 47386473 by 58736, you will find the Quotient to be 806, and 45257 will remain after the work is ended.

In like manner if you would divide 3846739204 by 483064, the quotient will be 7963, and the remainder after Diviſion will be 100572.

Compendiums in Diviſion.

1. IF any given Number be to be divided by another number that hath Cyphers annexed on the right ſide thereof, (omitting the Cyphers) you may cut off ſo many Figures from the right hand of the dividend, as there are Cyphers before the diviſor, and let the remaining Numbers in the dividend, be divided by the remaining number or numbers in the diviſor, obſerving this Caution, that if after your Diviſion is ended any thing remain, you are to annex hereto, the *number* or *numbers* that were cut off from the *dividend*; and ſuch new found *number* ſhall be the Remainder. As for Example: Let it be required to divide 46658 by 400; now becauſe there are two Cyphers before the Diviſor, I cut off as many Figures from before the Dividend, *viz.* 58, ſo that then there will remain only 466 to be divided by 4, and the quotient will be 116, and there will remain 2, to which I annex the two Figures (58) which were cut off from the dividend, and it makes 258 for the true remainder, ſo that I conclude 46658 being divided by 400, the quotient will be 116, and 258 remaineth after the Work is ended; as by the Work in the Margent.

Et ſi Diviſor adjunctos ſibi habeat Circulos ad dextram, omiſſis circulis & abſciſſis totidem ultimis Figuris dividendi in numeris reliquis fiat diviſio, in fine autem diviſionis reſtituendi ſunt tum omiſſi circuli; tum figuræ abſciſſæ. Ought. Cla. Math. cap. 5. 3.

```
4|00) 466 |58 (116
      ...
      4
      ---
       6
       4
      ---
       26
       24
      ----
     (258)
```

2. And hence it followeth that if the diviſor be (1 or a Unit with Cyphers annexed, you may cut off ſo many figures from the end of the dividend, as there are Cyphers in the diviſor, and then the figure or figures that are on the Left-hand, will be the Quotient, and thoſe that are on the Right-hand will be the Remainder after the Diviſion is ended: As thus, if 45783 were to be divided by 10, I cut off the laſt figure (3) with a daſh thus (4578|3) and the work is done, and the quotient is 4578 (the number on the left hand of the daſh) and the remainder is 3(on the right-hand); in like manner if the ſame number 45783 were to be divided by 100, I cut off two figures from the end thus (457|83) and the quotient is 457, and the remainder is 83. And if I were to divide the ſame by 1000, I cut off 3 figures from the end thus, (45|783) and the Quotient is 45, and 783 the remainder, *&c.*

Diviſurus quemcunque numerum per 10. Aufer ex dextra parte unicam, eamque primam figuram: Reliquæ enim figuræ productum oſtendunt. Ablatum Reſiduum, &c. *Gem. Friſ. Arith. part.* 1.

6. The General Effect of Diviſion is contained in the definition of the ſame, (that is) by having two unequal Numbers given, to find a third Number in ſuch proportion to the dividend, as the diviſor hath to Unit or 1; it alſo diſcovers what reaſon or proportion there is between numbers, ſo if you divide 12 by 4, it quotes 3, which ſhews the reaſon or proportion of 4 to 12 is triple.

The ſecond Effect is, by the ſuperficial meaſure or content, and the length of any Oblong, Rectangular, Parallelogram, or ſquare plane known, to find out the breadth thereby, or contrariwiſe, by having the ſuperficies and breadth of the ſaid figure, to find out the length thereof. Alſo by having the ſolidity and length of a ſolid, to find the ſuperfices of the Baſe, *& e contra.*

The third Effect is, by the Contents, Reaſon, Price, Value, Buying, Selling, Expences, Wages, Exchange, Intereſt, Profit or Loſs of any number of things (be it Money, Merchandize, or what elſe) to find out the

Contents, Reaſon, Price, Value, Buying, Selling, Expence, Wages, Exchange, Intereſt, Profit or Loſs, of any one thing of like kind.

The fourth Effect is, to aid, to compoſe and to make other Rules, but principally the Rule of Proportion, called the Golden Rule, or Rule of Three, and the Reduction of Moneys, Weights, and Meaſures, of one denomination into another, by it alſo Fractions are abbreviated by finding a common Meaſurer, unto the Numerator and Denominator, thereby diſcovering commenſurable Numbers.

If you divide the value of any certain quantity by the ſame quantity, the quotient diſcovers the rate or value of the Integer; as if 8 yards of Cloth coſt *96* ſhillings, if you divide (*96*) the value or price of the given quantity, by (8) the ſame quantity, the quotient will be 12, which is the price or value of 1 of thoſe yards, *& e contra.*

If you divide the value or price of any unknown quantity, by the value of the Integer, it gives you in the quotient that unknown quantity whoſe price is thus divided; as if 12 ſhillings were the value of 1 yard, I would know how many yards are worth *96* ſhillings: Here if you divide (*96*) the price or value of the unknown quantity, by (12) the rate of the Integer, or one yard, the quotient will be 8, which is the number of yards worth *96* ſhillings.

Some Queſtions anſwered by Diviſion may be theſe following.

Queſt. 1. If 22 things coſt *66* ſhillings, what will 1 ſuch thing coſt? *Facit*, 3 ſhillings; for if you divide *66* by 22, the quotient is 3 for the Anſwer; ſo if *36* yards or ells of any thing be bought or ſold for 108 *l.* how much ſhall 1 yard or ell be bought or ſold for? *Facit* 3 *l.* for if you divide 108 *l.* by *36* yards, the quotient will be 3 *l.* the price of the Integer.

Queſt. 2. If the Expence, Charges or Wages of 7 years amount to 868 *l.* what is Expence, Charges or Wages of one year? *Facit* 124 *l.* for if you divide

868 (the Wages of 7 Years) by 7 (the number of Years) the quotient will be 124 *l.* for the Anſwer. See the Work,

```
7) 868 (124
   ...
   7
  ---
   16
   14
   ---
    28
    28
   ---
   (0)
```

Queſt. 3. If the content of one ſuperficial Foot be 144 Inches, and the breadth of a Board be 9 Inches, how many Inches of that Board in length will make ſuch a Foot? *Facit* 16 Inches; for by dividing 144 (the number of ſquare Inches in a ſquare Foot) by 9 (the Inches in the breadth of the Board) the Quotient is 16 for the number of Inches in length of that Board to make a ſuperficial Foot.

```
9) 144 (16 Inches
   ...
   9
  ---
   54
   54
  ---
  (0)
```

Queſt. 4. If the content of an Acre of Ground be 160 ſquare Perches, and the length of a Furlong (propounded) be 80 Perches, how many Perches will there go in breadth to make an Acre? *Facit*, 2 Perches; for if you divide 160 (the number of Perches in an Acre) by 80 (the length of the Furlong in Perches) the Quotient is 2 Perches; and ſo many in breadth of that Furlong will make an Acre.

80) 160 (2 *Perches*
•
160
———
(0)

Queſt. 5. If there be 893 Men to be made up into a battle, the front conſiſts of 47 Men, what number muſt there be in the File? *Facit*, 19 deep in the File: For if you divide 893 (the number of Men) by 47 (the number in front) the quotient will be 19 File in depth; the Work followeth.

47) 893 (19 *deep in file*
••
47
———
423
423
———
(0)

Queſt. 6. There is a Table whoſe ſuperficial content is 72 feet, and the breadth of it at the end is 3 feet, now I demand what is the length of this Table? *Facit*, 24 feet long; for if you divide 72 (the content of the Table in feet) by 3 (the breadth of it) the Quotient is 24 feet for the length thereof, which was required. See the Operation as followeth;

3) 72 (24
•
6
———
12
12
———
(0)

The Proof of Multiplication and Diviſion.

Multiplication and *Diviſion* interchangeably prove each other; for if you would prove a Sum in *Diviſion*, whether the Operation be right or no, multiply the quotient by the diviſor; and if any thing remain after the *Diviſion* is ended, add it to the product, which product (if your Sum was rightly divided) will be equal to the dividend: And contrariwiſe, if you would prove a Sum in *Multiplication*, divide the product by the multiplier, and if the Work was rightly performed, the quotient will be equal to the multiplicand. See the Example where the Work is done and undone. Let 7654 be given to be multiplied by 3242, the product will be 24814268, as by the Work appeareth.

```
     7654
     3242
    ------
    15308
   30616
  15308
 22962
---------
 24814268
```

And then if you divide the ſaid product 24814268 by 3242 the multiplier, the quotient will be 7654, equal to the given multplicand.

```
3242) 24814268 (7654
          ....
      22694
      -----
       21202
       19452
       -----
        17506
        16210
        -----
         12968
         12968
         -----
          (0)
```

In like manner (to prove a Sum or Number in *Diviſion*) if 24814268 were divided by 3242 the Quotient will be found to be 7642; then for proof, if you multiply 7654 the quotient by 3242 the diviſor, the product will amount to 24814268, equal to the dividend.

Or you may prove the laſt, or any other Example in *Multiplication* thus, *viz.* divide the product by the multiplicand, and the Quotient will be equal to the Multiplier. See the Work.

```
             7654
             3242
           ------
            15308
           30616
          15308
         22962
         --------
7654) 24814268 (3242
          ....
        22962
        -----
         18522
         15308
         -----
          32146
          30616
          -----
           15308
           15308
          -------
            (0)
```

From whence there ariſeth this Corollary, that any Operation in *Diviſion* may be proved by *Diviſion*; for if after your *Diviſion* is ended, you divide the dividend by the quotient, the new quotient thence ariſing, will be equal to the diviſor of the firſt Operation; for tryal whereof let the laſt Example be again repeated.

3242) 24814268 (7654
....
22694

21202
19452

17506
16210

12968
12968

(0)

For proof whereof divide again 24814268 by the Quotient 7654, and the Quotient hence will be equal to the firſt Diviſor 3242; ſee the Work.

7654) 24814268 (3242.
....
22962

18522
15308

32146
30616

15308
15308

(0)

But in proving *Diviſion* by *Diviſion*, the Learner is to obſerve this following Caution, that if after his *Diviſion* is ended there be any remainder, before you go about to prove your work, ſubtract that Remainder out of your dividend, and then work as before, as in the following Example, where it is required to divide 43876 by 765, the Quotient here is 57, and the remainder is 271; ſee the Work following.

765)

```
765) 43876 (57
     ..
     3825
     ----
      5626
      5355
      ----
     (271)
```

Now to prove this Work, ſubtract the remainder 271 out of the dividend 43876, and there remaineth 43605 for a new dividend to be divided by the former quotient 57, and the quotient thence ariſing is 765 equal to the given Diviſor, which proveth the Operation to be right.

```
     43876
       271
     -----
57) 43605 (765
    ...
    399
    ---
     370
     342
     ---
      285
      285
      ---
      (0)
```

Thus have we gone through the four Species of Arithmetick, *viz. Addition, Subtraction, Multiplication,* and *Diviſion*; upon which all the following Rules and all other Operations whatſoever that are poſſible to be wrought by Numbers have their immediate dependance, and by them are reſolved. Therefore before the Learner make a further ſtep in this Art, let him be well acquainted with what hath been delivered in the foregoing Chapters.

Hæ ſunt igitur quatuor illæ ſpecies Arithmetices per quas omnia quæcunque deinceps dicenda ſunt vel quæ per numeros fieri poſſibile eſt, abſolvuntur. Quare eas quiſquis es ante omnia perdiſces. Gem. Friſ. Arith. par. 1.

CHAP.

CHAP. VIII.

Of Reduction.

1. R*Eduction* is that which brings together two or more numbers of different denominations into one denomination, or it ſerveth to change or alter Numbers, Mony, Weight, Meaſure of Time, from one denomination to another; and likewiſe to abridge Fractions to their loweſt Terms. All which it doth ſo preciſely, that the firſt proportion remaineth without the leaſt jot of Error or Wrong committed; ſo that it belongeth as well to Fractions as Integers, of which in its proper place. *Reduction* is generally performed, either by *Multiplication* or *Diviſion*; from whence we may gather, that,

Hill's Arith. c.13.*p.* 152.

2. *Reduction* is either deſcending or aſcending.

3. *Reduction* deſcending, is when it is required to reduce a Sum or Number of a greater denomination, into a leſſer; which Number, when it is ſo reduced, ſhall be equal in value to the Number firſt given in the greater denomination; as if it were required to know how many *ſhillings pence* or *farthings* are equal in value to an *hundred pounds*? or how many *ounces* are contained in 45 *hundred weight*? or how many *days*, *hours* or *minutes* there are in 240 *years*, &c. And this kind of *Reduction* is generally performed by *Multiplication*.

Wing. Arith. ch. 7. 2 3, 4.

4. *Reduction* aſcending, is when it is required to reduce or bring a Sum or Number of a ſmaller denomination into a greater, which ſhall be equivalent to the given number; as ſuppoſe it were required to find out how many Pence, Shillings or Pounds are equal in value to 43785 Farthings; or how many hundreds are equal to (or in) 3748 Pounds, &c. and this kind of *Reduction* is always performed by *Diviſion*.

5. When a Sum or Number it given to be reduced into another denomination, you are to conſider whe-

ther it ought to be reſolved by the Rule deſcending or aſcending, *viz.* by Multiplication or Diviſion: If it be to be performed by Multiplication, conſider how many parts of the denomination into which you would reduce it, are contained in a Unit or Integer of the given number, and multiply the ſaid given number thereby, and the product thereof will be the Anſwer to the Queſtion. As if the queſtion were, in 38 *Pounds*, how many *Shillings*? Here I conſider, that in one Pound are 20 Shillings, and that the number of *ſhillings* in 38 *pounds* will be 20 times 38, wherefore I multiply 38 *l.* by 20, and the product is 760, and ſo many *ſhillings* are contained in 38 *pounds*, as in the Margent.

38
20
———
760

But when there is a denomination, or denominations between the number given, and the number required, you may (if you pleaſe) reduce it into the next inferiour denomination, and then into the next lower than that, *&c.* until you have brought it into the denomination required: As for Example. Let it be demanded, in 132 *pounds* how many *farthings*? Firſt, I multiply 132 (the number of *pounds* given) by 20, to bring it into *ſhillings*, and it makes 2640 *ſhillings*, then do I multiply the *ſhillings* (2640) by 12, to bring them into *pence*, and it produceth 31680, and ſo many *pence* are contain'd in 2640 *ſhillings*, or 132 *pounds*; then do I multiply the *pence*, *viz.* 31680 by 4 to bring them into *farthings* (becauſe 4 *farthings* is a *penny*) and I find the *product* thereof to be 126720, and ſo many *farthings* are equal in value to 132 *pounds*, the Work is maniſeſt in the Margent.

132 *pounds*
20
———
2640 *ſhill.*
12
———
5280
2640
———
31680 *pence*
4
———
126720 *farth.*

6. And if the number propounded to be reduced, is to be divided, or wrought by the Rule Aſcending,

conſider how many of the given numbers are equal to an Unit or Integer, in that denomination to which you would reduce your given number, and make that your diviſor, and the given number your dividend; and the quotient thence ariſing will be the number ſought or required: As for Example, Let it be required to reduce 2640 Shillings into Pounds. Here I conſider that 20 Shillings are equal to one Pound; wherefore I divide 2640 (the given Number) by 20, and the Quotient is 132, and ſo many Pounds are contained in 2640 Shillings. In Reduction deſcending and aſcending the Learner is adviſed to take particular notice of the Tables delivered in the ſecond Chapter of this Book, where he may be informed what Multipliers or Diviſors to make uſe of in the reducing of any Number to any other denomination whatſoever, eſpecially *Engliſh* Moneys, Weights, Meaſures, Time and Motion; but in this place it is not convenient to meddle with Foreign Coins, Weights or Meaſures.

```
               l.
2|0)  264|0  (132
      ...
      2
      ---
       6
       6
      ---
       4
       4
      ---
      (0)
```

But if in Reduction aſcending it happen that there is a denomination or denominations between the number given, and the number required, then you may reduce your number given into the next ſuperiour denomination, and when it is ſo reduced, bring it into the next above that, and ſo on until you have brought it into the denomination required. As for Example,

Let it be demanded in 126720 *farthings* how many *Pounds*? Firſt, I divide my given *number* (being *farthings*) by 4, to bring them into *pence* (becauſe 4 *farthings* make one *penny*) and they are 31680 *pence*, then I divide 31680 *pence* by 12, and the Quotient giveth 2640 *ſhillings*, and then I divide 2640 *ſhillings* by 20, and the quotient giveth 132 *pounds*, which are equal in value to 126720 *farthings*. See the whole Work as it followeth.

```
          12)       2|0)   l.
4) 126720 (31680 (264|0 (132
   .....   .....  ..
   12      24      2
   --      --     --
    6      76      6
    4      72      6
   --      --     --
    27     48      4
    24     48      4
   --      --     --
     32   (00)    (0)
     32
     --
     (0)
```

7. When the *number* given to be reduced, conſiſteth of divers denominations, as *pounds*, *ſhillings*, *pence*, and *farthings*, or of *hundreds*, *quarters*, *pounds* and *ounces*, &c. then you are to reduce the higheſt (or greateſt) denomination into the next inferiour, and add thereunto the number ſtanding in that denomination which your greateſt or higheſt number is reduced to; then reduce that Sum into the next inferiour Denomination, adding thereto the number ſtanding in that denomination; do ſo untill you have brought the number given into the denomination propoſed. As if it were required to reduce 48 *l.* 13 *s.* 4 *d.* into pence; firſt I bring 48 *l.* into ſhillings, by multiplying it by 20, and the product is 960 ſhillings, to which I add the 13 ſhillings, and they make 973, then I multiply 973 by 12, to bring the ſhillings into pence, and they make 11676 pence, to which I add the 10 pence, and they make 11686 pence for the Anſwer. See the Wbrk done.

l. s. d.
48—13—10
20

960 *ſhillings*
Add 13

Sum 973 *ſhillings*
12

1946
973

11676 *pence*
Add 10

Sum 11686 *pence*

8. If in Reduction Aſcending after Diviſion is ended, any thing remain. ſuch remainder is of the ſame denomination with the dividend.

Example. In 4783 *farthings*, I demand how many *pounds?*

Firſt, I divide the given number of *farthings*, (*viz.* 4783) by 4 to bring them into *pence*, and the quotient is 1195 *pence.* and there remaineth 3 after the Work of *Diviſion* is ended, which is 3 *farthings.*

Again, I divide 1195 *pence* (the ſaid quotient) by 12, to reduce them into *ſhillings*, and the quotient is 99 *ſhillings*, and there is a remainder of 7, which is 7 *pence.*

And then I divide 99 *ſhillings* (the laſt quotient) by 20, to bring it into *pounds*, and the quotient is 4 *l.* and there remaineth 19 *ſhillings*; ſo that I conclude that in 4783 (the propoſed number of *farthings*) there is 4 *pounds* 19 *ſhillings*, 7 *pence*, 3 *farthings.* View the following Operation.

4)

```
                  12) 2|0
4)  4783  (1195  (9|9  (4 pounds
    ••••     •
    4       108    8
   ----     ---   ---
      7     115  (19) ſhillings
      4     108
   ----     ---
     38 rem. (7) pence
     36
    ---                l.  s.  d.  qrs.
     23      Facit  4—19—7—3
     20
    ---
 Rem. (3) farthings.
```

More Examples in Reduction of Coin.

Queſt. 1. In 438 *l.* how many *ſhillings?* *Facit* 8760 *ſhillings*; for by mnltiplying 438 by 20, the product amounteth to ſo much. See the Work.

```
438 pounds
 20
----
Facit 8760 ſhillings
```

Queſt. 2. In 467 *l.* how many *pence?* Firſt, multiply the given number of *pounds* (467) by 20 to bring it into *ſhillings*, and it makrs 9340 *ſhillings*, then multiply the *ſhillings* by 12, and it produceth 112080 *pence*, thus,

```
 467 pounds
  20 ſhillings
 ----
 9340 ſhillings
   12
 -----
 18680
 9340
 ------
Facit 112080 pence.
```

Or it may be reſolved thus, *viz.* multiply the given *number* of *pounds* (467) by (240) the *number* of *pence* in a *pound*, and the product is the ſame, *viz.* 112080 *pence*, as by the Operation appeareth.

467 *pounds*
240

18680
934

Facit 112080 *pence*

Queſt. 3. In 5673 *l.* how many *farthings?* Firſt, multiply the given *number* by 20, to bring it into *ſhillings*, and it produceth 113460 *ſhillings*, then multiply that *product* by 12, to bring it into *pence*, and it produceth 1361520 *pence*; then laſtly, multiply the *pence* by 4, and it produceth 5446080 *farthings*. See the Operation.

5673 *pounds*
20

113460 *ſhillings*
12

226920
113460

1361520
4

Facit 5446080 *farthings*

Or this Queſtion might have been thus reſolved, *viz.* Multiply 5673 (the given *number* of *pounds*) by 960 (the number of *farthings* in a *pound*) and it produceth the ſame Effect, as you may ſee by the Work.

5673 *pounds*	20 *ſhillings*
960	12
340380	240 *pence*
51057	4
Facit 5446080 *farthings*	960 *farthings*

Otherwiſe thus: Firſt bring the given *number* 5673 *l.* into ſhillings, and multiply the ſhillings by 48, the number of farthings in a ſhilling, and the ſame effect is thereby likewiſe produced, *viz.*

5673 *pounds*	12 *pence*
20	4
113460 *ſhillings*	48 *farthings*
48	
907680	
453840	
Facit 5446080 *farthings*	

Theſe various ways of operating are expreſſed to inform the Judgment of the Learner, with the Reaſon of the Rule; more ways may be ſhewn, but theſe are ſufficient even for the meaneſt Capacities.

Queſt. 4. In 458 *l.* 16 *s.* 7 *d.* 3 *qrs.* how many farthings? To reſolve this Queſtion conſider the ſeventh Rule of this Chapter, and Work as you are there directed, and you will find the aforeſaid given Number to amount to 440479 farthings, *viz.*

```
           l.   s.  d. qrs.
           458—16—7—3
             20
         ─────────
          9160 ſhillings
Add         16
         ─────────
Sum       9176 ſhillings
            12
         ─────────
         18352
         9176
         ─────────
        110112 pence
Add          7
         ─────────
Sum     110119 pence
             4
         ─────────
        440476 farthings
Add          3
         ─────────
Sum     440479 farthings
```

This laſt Queſtion (or any other of this kind, *viz.* where the number given to be reduced conſiſteth of ſeveral denominations) may be more conciſely reſolved thus, *viz.* when you multiply the *Pounds* by 20 to bring them into *Shillings*, to the product of the firſt Figure, add the Figure ſtanding in the place of Units in the denomination of *Shillings*, but becauſe the firſt Figure in the Multiplier is (o) I ſay o times 8 is nothing, but 6 is 6, which I put down for the firſt Figure in the product, then becauſe this multiplyer is o, I go on no further with it, for if I ſhould, the whole product will be o, but proceed, and when I come to by multiply the ſecond Figure in the multiplier, and to the product of it, I add the Figure ſtanding in the place of Tens in the denomination of *Shillings* which is (1) ſaying 2 times 8 is 16, and (the ſaid Figure) 1 is 17, then I ſet down 7, and carry an Unit to the product of the next Figure as is directed in the fifth Rule of the ſixth Chapter foregoing; and finiſh the Work. So that you now have the whole product and ſum of *Shillings* at one Operation, which is the ſame as before, and when you multiply the *Shillings* by 12, to bring them into *Pence* (after the ſame manner) add to the droduct the number ſtanding in the denomination of *Pence*, and ſo when you multiply the *Pence* by 4 to bring them into *Farthings*, add to the product the number ſtanding under the denomination of *Farthings*. See the laſt Queſtion thus wrought.

```
     l.   s.  d. qrs.
    458—16—7—3
     20
    ____
   9176 Shillings
     12
   ____
  18359
  9176
  ____
 110119 Pence
      4
  _____
Facit 440479 Farthings
```

After the method laſt preſcribed (which if rightly conſidered, differeth not any thing from the 7th Rule of this Chapter) are all the following Examples that are of the ſame nature wrought and reſolved.

Queſt. 5. In 4375866 *Farthings*, I demand how many *Pounds*, *Shillings*, *Pence* and *Farthings?*

To reſolve this Queſtion; Firſt, I divide the given number of *Farthings* by 4, and the Quotient is 1093966 *Pence*, and there remaineth 2 after the Diviſion is ended (which by the 8th Rule foregoing) is two *Farthings*; then I divide 1093966 *Pence* by 12, and the

Quotient is 91163 ſhillings, and there remaineth 10 after Diviſion, which by the ſaid 8th Rule is ſo many pence, *viz.* 10*d.* then I divide 91163 ſhillings by 20, and the Quotient is 4558 *l.* and there remaineth 3 ſhillings, ſo the Work is finiſhed, and I find that in 4375866 farthings there are 4558 *l.* 3 *s.* 10 *d.* 2 *qrs.* See the Operation.

```
              12)        2|0)    l.
4) 4375866 (1093966 (9116|3 (4558
   .......   .......   ....
   4           108       8
   ----       -----    ----
   37          13       11
   36          12       10
   ----       -----    ----
    15         19       11
    12         12       10
   -----      -----    ----
     38        76       16
     36        72       16
    -----     -----    ----
      26       46       (3) s.
      24       36
    -----     -----
      26      (10) d.
      24
    -----
    (2) qrs.

       l.        s.      d.      qrs.
Facit 4558 ---- 3 ---- 10 ---- 2
```

Queſt. 6. In 4386 *l.* I demand how many Groats?

To reſolve this Queſtion, I reduce the given number of Pounds into Shillings, and they are 87720 Shillings, now I conſider that in a Shilling are 3 Groats, therefore I multiply the Shillings by 3, and it produceth 263160 Groats. See the Work.

4386

4386 *Pounds*
20

87720 *ſhillings*
3

Facit 263160 *Groats*

This Queſtion might have been otherwiſe rofolved thus, *viz.* conſidering that in a pound (or 20 ſhillings) there are 3 times 20 Groats, which make 60, by which I multiply the number of Pounds given, and it produceth the ſame Effect at one Operation, as followeth.

4386 *Pounds* 20
60 *Groats in* 20 *s.* 3

Facit 263160 *Groats in* 4386 *l.* 60

Queſt. 7. In 43758 three-pences, I deſire to know how many Pounds?

To reſolve this (and many ſuch like) Queſtions; Firſt, I divide my given Number of 3 pences by 4, becauſe 4 three-pences are in a Shilling, and the quotient is 10939 ſhillings, and there remaineth 2 after Diviſion is ended, which is 2 three-pences (by the 8th Rule of this Chapter) which are equal in value to *6 d.* then I divide 10939 ſhillings by 20, and the Quotient giveth 546 *l.* and 19 *s.* remain; ſo that I conclude in 43758 pieces of three-pence *per* piece, there are 546 *l.* 19 *s.* 6 *d.* as by the Work appeareth.

```
                 2|0       l.   s.   d.
   4) 43758 (1093|9 (546—19—6
      .....    ...
      4        10
      —        —
      37        9
      36        8
      ——       ——
       15      13
       12      12
       ——      ——
        38    (19) s.
        36
        ——
   (2) three pence or 6d.
```

This Queſtion might have been otherwiſe reſolved thus, firſt *viz.* multiply the given number of three pences 43758, by three the number of pence in three pence, and the product (*viz.* 131274) is the number of pence equal to the given number of three-pences, which number of pence may be brought into pounds by dividing by 12 and by 20, and the Quotient you will find to be equal to the former Works, *viz.* 546 *l.* 19 *s.* 6 *d.*

```
           43758
               3
       ————————         2|0)     l.    s.   d.
   12) 131274 (1093|9 (546—19—6
       ....     ...
       12       10
       ———      ——
       112       9
       108       8
       ———      ——
         47     13
         36     12
         ——     ——
         114 re. (19) ſhill.
         108
         ————
   Remains (6) pence.
```

Or thus, divide the given number of 3 pences by the number of 3 pences in a pound or 20 ſhillings (which you will find to be 80, if you multiply 20 *s.* by 4, the number of 3 pences in a ſhilling) and you will find the quote to be 546 *l.* as before, and a remainder of 78 three pences, and if you divide thoſe 78 three-pences by 4 (becauſe there are 4 three-pences in a ſhilling) you will find the quote to be 19 *s.* and 2 three-pences remain, which are equal to 6 *d.* which is the ſame that was before found.

```
                  l.  s.  d.
8|0) 4375|8 (546—19—6              20
     ...                            4
     40                            ——
     ——                            80
      37
      32
      ——
       55
       48
       ——
4) 78 (19 s.
   ..
   4
   ——
   38
   36
   ——
   (2) three-pences or 6 d.
```

Queſt. 8. In 4785 *l.* 19 *s.* how many pieces of $13\frac{1}{2}$ *d.* *per* piece?

This Queſtion cannot be reſolved by Reduction, deſcending or aſcending, abſolutely, (becauſe $13\frac{1}{2}$ *d.* is no even part of a pound) but rather by them both jointly, *viz.* by Multiplication and Diviſion; for if you bring the number given into half-pence, and divide the half-pence, by the half-pence, in $13\frac{1}{2}$ *d.* *viz.* 27, the quotient will be the Anſwer; for having brought 4785 *l.* 13 *s.* into half-pence, I find it make 2297112, which I divide by 27, (becauſe there are ſo many half-pence in 13½*d.* and the Quote gives 85078 pieces of 13½*d.*and 6 half-pence remain over and above observe the Work following.

l. s. d.
4785—13 13½*d.*
20 2

95713 *ſhillings* 27 *half-pence*
24 *half-pence in a ſhilling*

382852
191426

2297112 *half-pence in the given number.*

27) 2297112 (85078 *pieces of* 13½d.
• • • • •
216

137
135

211
189

222
216

Rem. (6) *half-pence.*

It would have produced the ſame Anſwer if you had reduced your given number into farthings, and divided by the farthings in 13½*d. viz.* 54 (for always the Dividend and the Diviſor muſt be of one denomination) and then you would have had a remainder of 12 farthings, which are equal in value to the former remainder of 6 half-pence, as you may prove at your leiſure.

Queſt. 9. In 540 Dollars at 4 *s.* 4 *d. per* Dollar, how many pounds *ſterling?*

Firſt, bring your given Number of Dollars into pence, and then your pence into pounds according to the former Directions. Thus in 4 *s.* 4 *d.* (*viz.* a Dollar) you will find 52 pence, by which multiply 540 Dollars, and it produceth 28080 pence, which if you divide by 240 (the pence in one pound) the Quotient will give you 117 *l.* which are equal in value to 540 Dollars, at 4 *s.* 4 *d. per* Dollar. Obſerve the Operation.

```
                                 s.  d.
           540                   4 — 4
            52                  12
       ———————                 —————
          1080                  52 pence
         2700
        ——————      l.
 24|0)  2808|0  (117
         . . .
        24
        ————
         40
         24
        ————
         168
         168
        ————
         (0)
```

The foregoing Queſtion might have been otherwiſe wrought, thus, *viz.* Multiply (540) your given number of Dollars, by 13 the number of Groats in a Dollar (or 4 *s.* 4 *d.*) and it produceth 7020 Groats, which divivide by 60 (the groats in 1 pound or 20 ſhillings) and the Quote is 117 *l.* as before. See the Work.

```
                 s.  d.
      544        4—4
       13        3
    ------     -----
     1620       13
     540
6|0) 702|0 (117 l.
     ...
     6
    ---
     10
      6
    ---
      42
      42
    ---
     (0)
```

Queſt. 10. In 547386 pieces of 4½*d.* *per* piece, I demand how many Pounds, Shillings, and Pence.

Firſt, Bring your given number of four pence halfpennies all into half pence, which you will do if you multiply by 9 the number of half-pence in 4½*d* and the product is 4926474 half-pence, which are brought into Pounds, if you divide them by 24 (the half-pence in a Shilling) and 20 (the Shillings in a Pound) it makes 10263 *l.* 9 *s.* 9 *d.* as by the Work.

547386

```
      547386                                         d.
           9                                         4½
     -------                                         2
                                                   -----
                 2|0)        l.                     9 half-pence
24) 4926474 (20526|9 (10263
    .......  .....
    48          2
    ----      ----
      126       05
      120        4
      ----     ----
        64      12
        48      12
       ----    ----
        167      6
        144      6
       ----    ----
         234   (9) s.
         216
      --------
```

Remains (18) *half-pence* or 9d.

l. s. d.
Facit 10263—9—9

Queſt. 11. In 4386 *l.* I demand how many pieces of 6 *d.* of 4 *d.* and of 2 *d.* of each an equal number? that is to ſay, what number of ſix-pences, groats, and two pences, will make up 4386 *l.* and the number of each equal?

The way to reſolve Queſtions of this Nature, is to add the ſeveral pieces (into which the given Number is to be brought) into one Sum, and to reduce the given number into the ſame denomination with their ſum, and to divide the ſaid given number (ſo reduced) by the ſaid ſum, and the Quotient will give you the exact number of each piece. And after the ſame Method will we proceed to reſolve the preſent Queſtion, *viz.*

```
        4386 pounds
         240 pence
       ———————
      175440
      8772
      ———————
  12) 1052640 (87720
      .....
      96
      ——
       92
       84
       ——
        86
        84
        ——
         24
         24
         ——
         (0)
```

```
     6
     4
     2
    ——
Sum 12 pence
```

```
                        d.  d.  d.
Facit 87720 pieces of  6 —  4 — 2
```

So that I conclude by the operation that 87720 ſix pences, and 87720 groats, and 87720 two-pences are juſt as much as (or equal to) 4386 *l.* or if you admit of 5 *s.* to be thus divided, it is equal to 5 ſix-pences, and 5 four-pences or groats, and 5 two-pences. *For if two Right Lines (or two Numbers) be given, and one of them be divided into as many Parts, or Segments as you pleaſe, the Rectangle (or Product) comprehended under the two whole right lines (or numbers) given ſhall be equal to all the Rectangles (or Products) contained under the whole line (or number) and the ſeveral Segments (or Parts) into which the other linl or number) is divided.* Eucl. 2. 1.

Another Queſtion of the ſame Nature with the laſt may be this following, *viz.*

Queſt. 12. A Merchant is deſirous to change 148 *l.* into pieces of 13 *d.* ½ of 12 *d.* of 9 *d.* of 6 *d.* and of 4 *d.*; and he will have of each ſort an equal number of pieces, I deſire to know the nnmber?

Do as you were taught in the laſt Queſtion, *viz.* add the ſeveral pieces together, and reduce the Sum into half-pence, then reduce the Sum to be changed, *viz.* 148 l. into the ſame denomination, and divide the greater by the leſſer, and in the Quotient you will find the Anſwer, *viz.* 798, is the Number of each of the pieces required, and 18 remaineth, which is 18 half-pence by the 8th Rule of this Chapter. See the Work as followeth.

l.		d.
148		$13\frac{1}{2}$
240 *pence in a* l.		12
		9
5920		6
296		4
35520 *pence in* 148 *l.*	*Sum*	44
2		$2\frac{1}{2}$
71040 *half-pence*		89 *half-pence*

89) 71040 (798 *pieces of each ſort*
623
874
801
730
712
Rem. (18) *half-pence.*

The truth of the two foregoing Operations will thus be proved, *viz.* multiply the Anſwer by the parts, or pieces into which the given Number was reduced, and having added the ſeveral products together, if their Sum be equal to the given number, the Anſwer is right, otherwiſe not.

So the Anſwer to the 11th Queſtion was 87720, which is proved as followeth, *viz.*

87720

		l.
87720	*Six-pences make*	2193
	Four-pences make	1462
	Two-pences make	731
	The total Sum of them	4386

which was the Sum given to be changed.

The Anſwer to the 12th Queſtion was 798, and 18 half-pence remained after the Work was ended, now the truth of the Work may be proved as the former was, *viz.*

		l.	s.	d.
798	*Pieces of* 13½ *make*	44	17	09
	Pieces of 12 *make*	39	18	00
	Pieces of 9 *make*	29	18	06
	Pieces of 6 *make*	19	19	00
	Pieces of 4 *make*	13	06	00
and 18 *half-pence*, or 9d. *remains*		00	00	09
The Total Sum of them		148	00	00

which total ſum is equal to the number that was firſt given to be changed, and therefore the Operation was rightly performed.

Reduction of Troy-weight.

We come now to give the Learner ſome Examples in *Troy-weight*, wherein we ſhall be brief, having given ſo large a Taſte of Reduction in the foregoing Examples of Coyn, and now the Learner muſt be mindful of the Table of *Troy-weight* delivered in the ſecond Chapter of this Book.

Queſt. 13. In 482 *l.* 07 *oz.* 13 *p.w.* 21 *gr.* how many Grains?

Multiply by 12, by 20, and by 24, taking in the Figures ſtanding in the ſeveral denominations, according to the Direction given in the 7th Rule of this Chapter, and you will find the product to be 2783013 Grains, which is the Number required, or Anſwer to the Queſtion. See the whole Work as followeth.

```
 l.   oz. p.w. gr.
482—7—13—21
 12
-----
  971
 482
-----
 5791 ounces
   20
-------
115833 penny-weights
    24
-------
 463333
231668
-------
```

Facit 2780013 *grains*

Queſt. 14. In 2780013 *grains*. I demand how many pounds, ounces, penny-weights and grains?

This is but the foregoing Queſtion inverted, and is reſolved by dividing 24 by 20, and by 12, and the Anſwer is 482 *l.* 7 *oz.* 13 *p.w.* 21 *gr.*

```
                  2|0)       12)      l.
24)  2780013   (11583|3   (5791    (482
     .......    .....      ...

      24          10        48
     ----        ----      ----
      38          15        99
      24          14        96
     ----        ----      ----
      140         18        31
      120         18        24
     -----       ----      ----
      200          3   Rem. (7) ounces
      192          2
     -----       ----
       81 Rem. (13) penny weight
       72
      ----
       93            l.   oz. p.w.  g.
       72     Facit 482—7—15—21
      ----
Remains  (21) grains
```

Queſt. 15. A Merchant ſent to a Goldſmith 16 Ingots of Silver, each containing in weight 2*l.* 4 *oz*, and ordered it to be made into Bowls of 2 *l.* 8 *oz. per* Bowl, and Tankards of 1 *l.* 6 *oz. per.* piece, and Salts of 10 *oz.* 10 *p.w. per* Salt, and Spoons of 1 *oz.* 18 *p.w. per* Spoon; and of each an equal number, I deſire to know how many of each ſort he muſt make?

This Queſtion is of the ſame nature with the 11 and 12 Queſtions foregoing, and may be anſwered after the ſame Method; *viz.* Firſt, add the weight of the ſeveral Veſſels (into which the Silver is to be made) into one Sum, and reduce it to one Denomination, and they make 1248 penny-weights; then reduce the weight of the Ingot into the ſame denomination, (*viz.* penny-weights, and it makes 560 penny-weights) and multiply them by the number of Ingots, *viz.* 16, and the product will give you the weight of the 16 Ingots, *viz.* 8960, then divide this product by the weight of the Veſſels, *viz.* 1248, and the Quotient giveth you the Anſwer to the Queſtion, *viz.* 7, and 224 *p.w.* remaining over and above.

l. *oz.*
2—4
12
28
20
560 *penny-weights*
16 *Ingots*
3360
560
1248) 8960 (7 *Veſſels of each*
8736
Rem. (224) *penny-weights*

l. *oz.* *p.w.*
2—08—00
1—06—00
0—10—10
0—01—18
Sum 5—02—18
12
62
20
1248 *p.w.*

The Proof of the Work is as followeth, viz.

		l. oz. p.w.		l. oz. pow.
7	*Bowls of*	2—08—00	*per Bowl is*	18—08—00
	Tank. of	1—06—00	*per Tank. is*	10—06—00
	Salt of	0—10—10	*per Salt is*	06—01—10
	Spoons of	0—01—18	*per Spoon is*	01—01—06
	224 *penny-weight remaining*		*is*	00—11—04
			Total Sum	37—04—00

So that you ſee the Sum of the Weights of each Veſſel, together with the Remainder is 37 *l.* 4 *oz.* which is equal to the Weight of the 16 Ingots delivered. For if 37 *l.* 4 *oz.* be reduced to penny-weights, it makes 8960.

Reduction of Averdupois Weight.

In Reducing *Averdupois Weight*, the Learner muſt have recourſe to the Table of *Averdupois Weight* delivered in the Second Chapter foregoing.

Queſt. 16. In 47 *C.* 1 *qr.* 20 *l.* how many Ounces? Multiply by 4, by 28, and by 16, and the laſt product will be the Anſwer, *viz.* 84992 Ounces.

C. qr. l.
47—1—20
4

189 *quarters*
28

1512
380

5312 *l.*
16

31872
5312

Facit 84992 *Ounces*

Queſt. 17. In 84992 Ounces I demand how many *C. qrs. l. oz.*

This is the foregoing Queſtion inverted, and will be reſolved if you divide by 16, by 28, and by 4, and the Anſwer is 47 *C.* 1 *qr.* 20 *l.* equal to the given Numbers in the foregoing Queſtion.

```
                 28)      4)     C.   qr.  l.
16) 84992     (5312     (189   (47—1—20
    ....       ...        ..
    80         28         16
    ——         ——         ——
    49         251        29
    48         224        28
    ——         ——         ——
     19         272       (1) qr.
     16         252
     ——         ——
      32        (20) l.
      32
      ——
      (0)
```

Queſt. 18. A Chapman buyeth of a Grocer 4 *C.* 1 *qr.* 14 *l.* of Pepper, and ordered it to be made up into Parcels of 14 *l.* of 12 *l.* of 8 *l.* of 6 *l.* and of 2 *l.* and of each parcel an equal number, now I would know the number of each parcel.

This Example is of the ſame nature with the 11, and 12, and 15 Queſtions foregoing, and after the ſame manner is reſolved. See the Operation as followeth.

4 *C.*

C. *qr.* *l.*
4——1——14
4
―
17
28
―
140
35
―
42) 490 (11
42
―
70 *Facit 11 parcels of each.*
42
―
Rem. (28) *pounds*

l.
14
12
8
6
2
―
42 *pounds*

Reduction of Liquid Meaſure.

Queſt. 19. In 45 Tun of Wine, how many gallons? Multiply by 4, and by 63, the product is 11340 Gallons for the Anſwer.

45
4
―
180
63
―
540
1080
―
Facit 11340 *gallons*

Queſt. 20. In 43 Rundlets of Wine, each containing 18 Gallons, I demand how many Hogſheads?

Firſt, Find how many Gallons is in the 34 Rundlets; which you may do if you multiply 34 by 18, the content of a Rundlet, and the product is 612 Gallons, which you may reduce into Hogſheads if you divid them by 63, and the Quote will be 9 Hogſheads, an 45 Gallons. See the Work.

```
          34
          18
        ————
         272
          34
        ————
   63) 612 (9 hhds.
        •
       567
      ————
Rem. (45) gallons
              Facit 9 hhds 45 gallons.
```

Queſt. 21. In 12 Tuns how many Rundlets of 14 Gallons *per* Rundlet?

Reduce your Tuns into Gallons, and divide them by 14, the Gallons in a Rundlet, and the Quotient (216) is your Anſwer. See the Work following.

```
            12
             4
         ————
            48
            63
         ————
           144
          288
         —————
  14) 3024 (216
      •••
       28
      ————
        22
        14
       ————
         84
         84
        ————
        (0)          facit 216 Rundl.
```

Reduction of Long Meaſure.

Queſt. 22. I demand how many Furlongs, Poles, Inches and Barley-Corns will reach from *London* to *York*, it being accounted 151 miles?

	151	*miles*
	8	*furlongs in a mile*
	1208	*furlongs*
	40	*poles in a furlong*
	48320	*poles*
	11	*half-yards*
	48320	
	48320	
	531520	*half-yards*
	18	*inches in half a yard*
	4252160	
	531520	
	9567360	*inches*
	3	*barly-corns in an inch*
Facit	28702080	*barly-corns in* 151 *miles*

Queſt. 23. The Circumference of the Earth (as all other Circles are) is divided into 360 degrees, and each degree into 60 minutes, which (upon the Superficies of the Earth) are equal to 60 miles; now I demand how many miles, furlongs, perches, yards, feet, and Barly-corns will reach round the Globe of the Earth?

360 *degrees*
60 *minutes or miles in a degree*

21600 *miles about the Earth*
8 *furlongs in a mile*

172800 *furlongs about the Earth*
40 *pearches in a furlong*

6912000 *poles or perches about the Earth*
11 *half yards in a pearch*

6912000
6912000

---

2) 76032000 *half yards about the Earth*

(38016000 *yards, viz. the half yards*
3 *divided by 2.*

114048000 *feet about the Earth*
12 *inches in a foot*

228096000
114048000

1368576000 *inches about the Earth*
3 *barly-corns in an inch*

Facit 4105728000 *barly-corns*

And ſo many will reach round the World, the whole being 21600 miles? ſo that if any Perſon were to go round, and go 15 miles every day, he wou'd go the whole circumference in 1440 days, which is 3 years, 11 Months, and 15 days.

Reduction

Reduction of Time.

Queſt. 24. In 28 Years, 24 Weeks, 4 Days, 16 Hours, 30 Minutes, how many Minutes?

years *weeks* *days* *hours* *min.*
28——24——4——16——30
52 *weeks in a year*

60
142

1480 *weeks*
7

10364 *days*
24

41462
20729

248752 *hours*
60

14925150

Note, That in reſolving the laſt Queſtion after the method expreſſed, there is loſt in every Year 30 Hours. For the Year conſiſteth of 365 Days and 6 Hours, but by multiplying the Years by 52 Weeks, which is but 364 Days; you loſe 1 Day and 6 Hours every Year; wherefore to find an exact Anſwer, bring the odd Weeks, Days, and Hours into Hours, and then multiply the Years by the number of Hours in a Year, *viz.* 8766, and to the Product add the Hours contained in the odd time, and you have the exact time of Hours, which bring into Minutes as before. See the laſt Queſtion thus reſolved.

weeks days hou
24—4—1
7
172
24
694
345
4144 *hours*

days hou.
365—6
24
1466
730
8766 *hours in a year*

28
8766
172
172
197
228
249592 *hours*
60
14975520 *minutes in* 28 *years and* 4144 *hours.*

So you ſee that according to the method firſt uſed to reſolve this Queſtion, the Hours contained in the given time are 248752, but according to the laſt, beſt, or true Method, they are 249592, which exceeds the former by 840 hours.

But for moſt occaſions it will be ſufficient to multiply the given years by 365, and to the product add the days in the odd time, if there be any, and then there will be only a loſs of 6 hours in every year, which may be ſupplied by taking a fourth part of the given years, and adding it to the contained days, and you have your deſire.

Queſt. 25. In 438657540 minutes, how many years? *Facit* 834 *years,* 4 *days,* 19 *hours.*

8766)

```
                   8766)      years   days   hours
6|0) 438657540 (7310959 (834——4——19
     •••••••••     •••

      42           70128
     ————         ———————
      18           29815
      18           26298
     ————         ———————
       6           35179
       6           35064
     ————         ———————
       57      24) 115 (4 days
       54            •
      ————          96
       35         ——————
       30         (19) hours
      ————
        54
        54
       ————
        (0)
```

Queſt. 26. I deſire to know how many Hours and Minutes it is ſince the Birth of our Saviour Jeſus Chriſt to this preſent Year, being accounted 1700 Years?

This Queſtion is of the ſame Nature with the 24th foregoing, and after the ſame manner is reſolved, *viz.* Multiply the given number of Years by 8766, the product is 14902200 hours, and that by 60, and the product is 894132000 Minutes. See the Work.

```
     1700 years
     8766 hours in a Year
    ——————
    10200
   10200
  11900
 13600
—————————
 14902200 hours in 1700 Years.
       60
—————————
894132000 min. in 1700 years
```

Note that as Multiplication and Diviſion do interchangeably prove each other, ſo Reduction deſcending and aſcending, prove each other, by inverting the Queſtion, as the 13 and 14, and likewiſe the 16 and 17 Queſtions foregoing, by Inverſion, do interchangeably prove each other, the like may be performed for the proof of any Queſtion in Reduction whatſoever.

Thus far have we diſcourſed concerning ſingle Arithmetick, whoſe Nature and Parts are defined in the ſecond, eighth, ninth, and tenth definitions of the third Chapter of this Book, for although Reduction is not reckoned or defined among the parts of ſingle Arithmetick, yet conſidered abſtractly, it is the proper effect of Multiplication and Diviſion; and as for the extraction of Roots (which ought to be handled in the next place as parts of ſingle Arithmetick) we ſhall omit it in this place, and refer the Learner to Mr. *Cocker's* Decimal Arithmetick, which is (with great care and pains) now publiſhed, together with his Logarithmetical Arithmetick, ſhewing the Geneſis or Fabrick of the Logarithms, and their general uſes in Arithmetick, *&c.* As alſo his Algebraical Arithmetick, containing the Doctrine of compoſing and reſolving an Equation, with all other Rules neceſſary for the underſtanding of that Myſterious Art, *&c.*

CHAP. IX.

Of Comparative Arithmetick; viz. *The Relation of Numbers one to another.*

1. Comparative Arithmetick is that which is wrought by Numbers, as they are conſidered to have relation one to another, and this conſiſts either in Quantity, or in Quality.

Boetius Arith. lib. 1. *cap.* 21.

2. Relation of Numbers in Quantity, is the reference or reſpect that the Numbers themſelves have one to another, where the Terms or Numbers propounded are always two, the firſt called the Antecedent, and the other the Conſequent.

Vide Wing. Arith. cap. 34.

3. The relation of Numbers and Quantity conſiſts in the differences, or in the rate or reaſon that is found betwixt the Terms propounded, the difference of two Numbers being the remainder found by Subtraction, but the rate or reaſon betwixt two numbers is the Quotient of the Antecedent divided by the Conſequent. So 21 and 7 being given, the difference betwixt them will be found to be 14, but the rate or reaſon that is betwixt 21 and 7 will be found to be triple reaſon, for 21 divided by 7 quotes 3, the reaſon or rate.

Alſted. Mathemat. lib. 2. *cap.* 11, & 12.

4. The relation of Numbers in Quality, (otherwiſe called Proportion) is the reference or reſpect that the reaſon of Numbers have one unto another; therefore the Terms given, ought to be more than two. Now this proportion or reaſon between Numbers relating one to another, is either Arithmetical, or Geometrical.

Alſted. Mathemat. lib. 2. *cap.* 21.

5. Arithmetical Proportion (by ſome called Progreſſion) is when divers Numbers differ one from another by equal Reaſon. that is, have equal differences.

So this rank of Numbers 3, 5, 7, 9, 11, 13, 15, 17. differ by equal Reaſon; *viz.* by 2, as you may prove.

6. In a rank of Numbers that differ by Arithmetical Proportion, the ſum of the firſt and laſt Term being multiplied by half the number of Terms, the product is the total ſum of all the Terms.

Or if you multiply the number of the Terms by the half ſum of the firſt and laſt Terms, the product thereof will be the total ſum of all the Terms.

So in the former Progreſſion given, 3 and 17 is 20, which multiplied by 4 (*viz.* half the number of Terms) the product gives 80, the Sum of all the Terms; or Multiply 8 (the Number of Terms) by 10 (half the Sum of the firſt and laſt Terms) the product gives 80 as before.

So alſo 21, 18, 15, 12, 9, 6, 3, being given, the Sum of all the Terms will be found to be 84; for here the number of Terms is 7, and the Sum of the firſt and laſt (*viz.* 21 and 3) is 24, half whereof (*viz.* 12.) Multiplied by 7 produceth 84, the Sum of the Terms ſought.

7. Three Numbers that differ by Arithmetical Proportion, the double of the mean (or middle number) is equal to the Sum of the Extreams.

So 9, 12, and 15 being given, the double of the mean 12 (*viz.* 24) is equal to the Sum of the Extreams 9 and 15.

8. Four numbers that differ by Arithmetical Proportion (either continued or interrupted) the Sum of the two Means is equal to the Sum of the two Extreams.

So 9, 12, 18, 21, being given, the Sum of 12 and 18 will be equal to the Sum of 9 and 21, *viz.* 30; alſo 6, 8, 14, 16 being given, the Sum of 8 and 14, is equal to the Sum of 6 and 16, *viz.* 22. *&c.*

Vide Wing. Arith. Cap. 35.

9. Geometrical Proportion (by ſome called Geometrical Progreſſion) is when divers numbers differ according to like Reaſon.

So 1, 2, 4, 8, 16, 32, 64, *&c.* differ by double Reaſon, and 3, 9, 27, 81, 243, 729, differ by triple Reaſon; 4, 16, 64, 256, *&c.* differ by quadruple Reaſon, *&c.*

10. In any numbers that increaſe by Geometrical Proportion, if you Multiply the laſt Term by the Quotient of any one of the Terms divided by another of the Terms, which being leſs is next unto it, and having deducted, or ſubtracted, the firſt Term out of that product, divide the remainder by a number that is an Unit leſs than the ſaid Quotient, the laſt Quote will give the Sum of all the Terms.

So, 1, 2, 4, 8, 16, 32, 64, being given, firſt I take one of the Terms, *viz.* 8, and divide it by the Term which is leſs and next to it, *viz.* by 4) and the Quotient is 2, by which I Multiply the laſt Term 64, and the product is 128, from whence I Subtract the firſt Term, (*viz.* 1) the remainder is 127, which divided by the Quotient 2 made leſs by 1 (*viz.* 1) the Quote is 127, for the Sum of all the given Terms, as by the Work in the Margent.

```
     64
4)   8 (2
  ------
    128
      1
  ------
1)  127 (127
```

So if 4, 16, 64, 256, 1024 were given, the Sum of all the Terms will be found to be 1364. For firſt, I divide 64, one of the Terms, by his next leſſer Term, and the Quotient is 4, by which I Multiply the laſt Term 1024, and it produceth 4096; from whence I Subtract the firſt Term 4, and the remainder is 4092, which I divide by the Quote leſs by 1 (*viz.* 3) and the Quote is 1364, for the total Sum of all the Terms, as *per* Margent.

```
      1024
16)   64 (4
   -------
      4096
         4
   -------
3)    4092 (1364
```

So likewiſe if 2, 6, 18, 54, 162, 486 were given, the Sum or Total of all the Terms will be found to be 728. See the Work.

```
      486
6)    18 (3
  --------
     1458
        2
  --------
2)   1456 (728
```

11. Three Geometrical Proportionals given, the Square of the Mean is equal to the Rectangle, or Product of the Extreams.

So 8, 16, 32, being given, the Square of the Mean, *viz.* 16, is 256, which is equal to the product of the Extreams 8 and 32, for 8 times 32 is equal to 256.

12. Of 4 Geometrical Proportional Numbers given, the product of the two Means is equal to the product of the two Extreams.

So 8, 16, 32, 64, being given, I ſay that the product of the two Means, *viz.* 16 times 32, which is 512 is equal to 8 times 64, the product of the Extreams

Alſo if 3, 9, 21, 63, were given (which are interrupted) I ſay 9 times 21 is equal to 3 times 63, which is equal to 189.

From hence ariſeth that precious Gem in Arithmetick, which for the Excellency thereof is called the *Golden Rule, or Rule of Three.*

CHAP. X.

The Single Rule of Three Direct.

1. THE *Rule of Three* (not undeſervedly call'd the *Golden Rule*) is, that by which we find out a fourth *number*, in *proportion* unto *three* given *Numbers*, ſo as this, *fourth Number* ſought may bear the ſame Rate, Reaſon, or Proportion to the *third* (given) *number*, as this ſecond doth to the firſt, from whence it is alſo called the Rule of *Proportion*.

2. Four *Numbers* are ſaid to be *Proportional*, when the firſt containeth or is contained by the ſecond, as often as the third containeth or is contained by the fourth. *Vide* Wingate's *Arith. Chap.* 8. *Sect.* 4.

So theſe *Numbers* are ſaid to be *Proportionals*, *viz.* 3, 6, 9, 18, for as often as the firſt *Number* is contained in the ſecond, ſo often is the third contained in the fourth, *viz.* twice. Alſo 9, 3, 15, 5, are ſaid to be *proportional*, for as often as the firſt *Number* containeth the ſecond, ſo often the third *Number* containeth the fourth; *viz.* 3 times.

3. The *Rule of Three* is either ſimple or compoſed.

4. The ſimple (or ſingle) *Rule of Three*, conſiſteth of 4 *Numbers*; that is to ſay, it hath 3 *Numbers* given to find out a fourth; and this is either Direct, or Inverſe. *Vide Alſted. Math. lib.* 2. *cap.* 13.

5. The ſingle *Rule of Three Direct*, is when the *proportion* of the firſt *Term* is to the ſecond, as the third is to the fourth; or when it is required that the *Number*

ſought (*viz.*) the fourth *Number* muſt have the ſame *proportion* to the ſecond, as the third hath to the firſt.

6. In the *Rule* of *Three*, the greateſt difficulty is (after the Queſtion is propounded) to diſcover the order of the 3 Terms, *viz.* which is the firſt, which is the ſecond, and which the third, which that you may underſtand, obſerve, That (of the three given *Numbers*) two are always of one kind, and the other is of the ſame kind with the proportional *Number* that is ſought; as in this Queſtion, *viz.* If 4 yards of Cloth coſt 12 ſhillings, what will 6 yards coſt at that rate? Here the two numbers of one kind are 4 and 6, *viz.* they both ſignify ſo many yards; and 12 ſhillings is the ſame kind with the number ſought, for the price of 6 yards is ſought.

Again, obſerve, that of the 3 given numbers, thoſe two that are of the ſame kind, one of them muſt be the firſt, and the other the third, and that which is of the ſame kind with the number ſought, muſt be the ſecond number in the Rule of *Three*; and that you may know which of the ſaid numbers to make your firſt, and which your third, know this, that to one of thoſe two numbers there is always affixed a demand, and that number upon which the demand lieth muſt always be reckoned the third number. As in the forementioned Queſtion, the demand is affixed to the number 6, for it is demanded what 6 yards will coſt; and therefore 6 muſt be the third number, and 4 (which is of the ſame denomination (or kind) with it muſt be the firſt, and conſequently the number 12 muſt be the ſecond, and then the numbers being placed in the forementioned order, will ſtand as followeth, *viz.*

yards	*s.*	*yards*
4	12	6

7. In the Rule of *Three Direct* (having placed the *numbers* as is before directed) the next thing to be done will be to find out the fourth *number* in proportion, which (that you may do) multiply the ſecond *number*

by

by the third, and divide the product thereof by the firſt, (or which is all one) Multiply the third term (or number) by the ſecond, and divide the product thereof by the firſt, and the Quotient thence ariſing is the 4th *number* in a direct proportion, and is the *number* ſought, or Anſwer to the Queſtion, and is of the ſame Denomination that the ſecond *number* is of. As thus, let the ſame Queſtion be again repeated, *viz.* If 4 yards of Cloth coſt 12 Shillings, what will 6 yards coſt?

Having placed my *numbers* according to the ſixth Rule (of this Chapter) foregoing, I multiply (the ſecond *number*) 12 by (the third number) 6, and the product is 72, which product I divide by (the firſt number) 4, and the Quotient thence ariſing is 18, which is the fourth proportional or number ſought, *viz.* 18 Shillings, (becauſe the ſecond number is Shillings) which is the price of the 6 yards, as was required by the Queſtion. See the Work following.

yds *s.* *yds* *s.*
If 4——12——6——18
6
———
4) 72 (18 *Shillings*
4
———
32
32
———
(0)

Queſt. 2. Another Queſtion may be this, *viz.* If 7 *C.* of Pepper coſt 21 *l.* how much will 16 *C.* coſt at that rate?

To reſolve which Queſtion, I conſider that (according to the 6th Rule of this Chapter) the terms or numbers ought to be placed thus, *viz.* the Demand lying upon 16 *C*, it muſt be the third number, and that of the ſame kind with it muſt be the firſt, *viz.* 7 *C.* and 21 *l.* (being of the ſame kind with the number ſought) muſt be the ſecond number in this Queſtion; then I proceed according to this 7th Rule, and Multiply the ſecond number of the third *viz.* 21 by 16, and the product is 336, which I divide by the firſt number 7, and the Quotient is 48 *l.* which is the value of 16 *C.* of Pepper at the rate of 21 *l.* for 7 *C.* *S*ee the Work following.

C. l. C.

If 7 ——— 21 ——— 16

16

126

21

7) 336 (48 *l.*

28

56

56 *Fac.* 48 *l.*

(0)

8. If when you have Divided the product of the Second and Third Numbers by the firſt, any thing remain after Diviſion is ended, ſuch Remainder may be Multiplyed by the parts of the next Inferiour Denomination, that are equal to an Unit (or Integer) of the Second number in the Queſtion, and the product thereof divide by the firſt number in the Queſtion, and the Quotient is of the ſame Denomination with the parts by which you Multiplyed the remainder, and is part of the fourth Number which is ſought, And furthermore, if any thing remain, after this laſt Diviſion is ended, Multiply it by the parts of the next inferiour denomination equal to an Unit of the laſt Quotient, and divide the product by the ſame Diviſor (*viz.* the firſt number in the Queſtion) and the Quote is ſtill of the ſame Denomination with your Multiplyer; follow this Method until you have reduced your Remainder into the loweſt Denomination, *&c.* An Example or two

will make the Rule very plain, which may be this following.

Queſt. 3. If 13 yards of Velvet (or any other thing) coſt 21 *l.* what will 27 yards of the ſame coſt at that rate?

Having ordered and wrought my numbers according to the 6 and 7 Rules of this Chapter, I find the Quotient to be 43 *l.* and there is a remainder of 8, ſo that I conclude the price of 27 yards to be more than 43 *l.* and to the intent that I may know how much more, I work according to the foregoing Rule, *viz.* I multiply the ſaid Remainder 8 by 20 *s.* (becauſe the ſecond number in the Queſtion was Pounds) and the product is 160, which divided by the firſt number, *viz.* 13, it quotes 12, which are 12 ſhillings, and there is yet a remainder of 4, which I multiply by 12 pence, (becauſe the laſt Quotient was ſhillings) and the product is 48, which I divide by 13 (the firſt number) and the Quotient is 3 *d.* and yet there remaineth 9, which I multiply by 4 Farthings, and the product is 36, which divided by 13 again, it quotes 2 Farthings, and there is yet a remainder of 10, which (becauſe it cometh not to the value of a Farthing) may be neglected, or rather ſet (aſter the 2 Farthings) over the diviſor, with a Line between them, and then (by the 21 and 22 Definitions of the firſt Chapter of this Book) it will be $\frac{10}{13}$ of a Farthing; ſo that I conclude, that if 13 *yards* of Velvet coſt 21 *l.* 27 *yards* of the ſame will coſt 43 *l.* 12 *s.* 3 *d.* 2$\frac{10}{13}$ *qrs.* which Fraction is 10 thirteenths of a Farthing. See the Operation as followeth.

yds. l. yds.
If 13 —— 21 —— 27
27

147
42

13) 567 43 *l.*
52

47
39

Rem. (8)
Multiply 20

13) 160 (12 *s.*
13

30
26

Rem. (4)
Multiply 12

13) 48 3 *d.*
39

(9)
Multiply 4

13) 36 ($2\frac{10}{13}$ *qrs.*
2

Rem. (10) *l.* *s.* *d.* *qrs.*
Facit 43 — 12 — 3 — $2\frac{10}{13}$

Quest. 4. Another Example may be this following, *viz.* If 14 *l.* of *Tobacco* coſt 27 *s.* what will 478 *l.* coſt at that rate?

Work according to the laſt Ru*le*, and you will find it to amount to 921 *s.* 10 *d.* 1$\frac{2}{14}$ *qrs.* and by the 5th Rule of the 8*th* Chapter 921 *s.* may be reduced to 46 *l.* 1 *s.* So that then the whole worth or value of the 478 *l.* will be 49 *l.* 1 *s.* 10 *d.* 1$\frac{2}{14}$ *qrs.* the whole Work followeth.

l. *s.* *l.*
If 14—27—478
27
3346
956
2|0
14) 12906 (921 (46 *l.*
126 8
30 12
28 12
26 (1) *s.*
14
Remains (12)
Multiply 12
24
12
24) 144 (10 *d.*
14
Remains (4)
Multiply 4
14) 16 (1$\frac{2}{14}$ *qr.*
14
Remains (2)
l. *s.* *d.* *qr.*
Facit 46—1—10—1$\frac{2}{14}$

9. In the Rule of Three it many times happeneth, that although the firſt and third numbers be Homogeneal (that is of one kind, as both Money, Weight, Meaſure, *&c.*) yet they may not be of one denomination, or perhaps they may both conſiſt of many denominations, in which caſe you are to reduce both numbers to one denomination; and likewiſe your ſecond number (if it conſiſteth (at any time) of divers denominations) muſt be reduced to the leaſt name mentioned, or lower if you pleaſe, which being done, Multiply the ſecond and third together, and divide by the firſt, as is directed in the 7th Rule of this Chapter.

And note, that always the Anſwer to the Queſtion is in the ſame denomination that your ſecond number is of, or is reduced to, as was hinted before.

Queſt. 5. If 15 Ounces of Silver be worth 3 *l.* 15 *s.* what are 86 Ounces worth at that rate?

In this Queſtion, the numbers being ordered according to the 6th Rule of this Chapter, the firſt and third numbers are Ounces, and the ſecond number is of divers Denominations, *viz.* 3 *l.* 15 *s.* which muſt be reduced to Shillings, and the Shillings multiplied by the third number, and the product divided by the firſt, gives you the Anſwer in Shillings, *viz.* 430 Shillings, which are reduced to 21 *l.* 10 *s.* See the Work.

```
        oz.    l.     s.     oz.
        15 —— 3 —— 15 —— 86
               20
              ————
               75
               86
             ————
              450
             600
        ——————————— 2|0    l.   s.
       15) 6450 (43|0(21 — 10
            ...    ..
            60      4
           ————   ————
            45      3
            45      2
           ————   ————
            (0)    (10)
```

In reſolving the laſt Queſtion, the Work would have been the ſame, if you had reduced your ſecond number into pence, for then the Anſwer would have been 5160 pence, equal to 21 *l.* 10 *s.* or if you had reduced the ſecond number into farthings, the Quotient or Anſwer would have been 29640 farthings equal to the ſame, as you may prove at your leiſure.

Queſt. 6. If 8 *l.* of Pepper coſt 4 *s.* 8 *d.* what will 7 *C.* 3 *qrs* 14 *l.* coſt?

In this Queſtion the firſt number is 8 *l.* and the third is 7 *C.* 3 *qrs* 14 *l.* which muſt be reduced to the ſame denomination with the firſt, *viz.* into pounds, and the ſecond number muſt be reduced into pence; then multiply and divide according to the 7th Rule foregoing, and you will find the Anſwer to be 6174 pence, which is reduced into 25 *l.* 14 *s.* 6 *d.*

```
    l.      s.  d.              C. qrs. l.
If  8 coſt  4—8   what will  7—3—14 coſt ?
            12                  4
            56                 31
                               28
                              252
                              62
                              882
                               56 ſecond number
                             5292
                            4410
                                    12)     2|0)   l.   s.  d.
                        8) 49392 (6174   (51|4  (25—14—6
                           ....    ...     ..
                           48      60      4
                            13      17     11
                             8      12     10
                            59      54    (14) s.
                            56      48
                            32     (6) d.
                            32
                                               l.  s.  d.
                           (0)  Facit      25—14—6  Queſt
```

Queſt. 7. If 3 *C.* 1 *qr.* 14 *l.* of Raiſins coſt 9 *l.* 9 *s.* what will 6 *C.* 3 *qrs.* 20 *l.* of the ſame coſt?

Here the firſt and third numbers each conſiſt of divers denominations, but muſt be brought both into one denomination, &c. as you ſee in the Operation which followeth; the Anſwer is 388 *s.* which is reduced into 19 *l.* 8 *s.*

```
    C. qr.  l.        l.  s.             C. qr.  l.
If  3—1—14  coſt  9—9  what will  6—3—20  coſt?
      4              20                   4
    -----          -----                -----
     13             189                  27
     28                                  28
    -----                               -----
    108                                 216
     27                                  56
    -----                              ------
    378 pounds                         776 pounds
                                        189 ſecond number
                                      --------
                                       6984
                                      6208
                                      776
                                   --------   2|0)   l.  s.
                              378) 146664  (38|8 (19—8
                                     ...      ..
                                   1134       2
                                   -----     ---
                                    3326      18
                                    3024      18
                                   -----     ---
          l.  s.                    3024     (8) s.
   Facit  19—8                      3024
                                   -----
                                    (0)
```

Queſt. 8. If in 4 Weeks I ſpend 13 *s.* 4 *d.* how long will 53 *l.* 6 *s.* laſt me at that rate?

Anſwer, 2298 *days* equal to 6 *years*, 48 *days*. See the Work.

```
    s.  d.             w.            l.  s.
If  13—4 require       4 what will   53—06
    12                 7             20
   ———               ———           ———————
    30               28 days       1066
    13                               12
   ———                             ———————
   160 pence                       2132
                                   1066
                                 ————————
                                  12792 pence
                                     28 second number
                                 ————————
                                 102336
                                 25584
                                 ———————— 365)
                         16|0) 35817|6 (2238 (6 years
                               ....     2190
                                32      ————
                               ———— Rema. (48) days
                                38
                                32
                               ————            ye. days
                                61       Facit 6—48 96/160
                                48
                               ————
                                137
                                128
                               ————
                         Remains (96)
```

Queſt. 9. Suppoſe the Yearly Rent of a Houſe, a Yearly Penſion, or Wages be 73 *l.* I deſire to know how much it is *per* day?

Here you are to bring the Year into Days, and ſay, if 365 Days require 73 *l.* what will 1 Day require?

¶ Now when you come to multiply 73 by 1, the product is the ſame, for 1 neither Multiplieth nor Divideth, and 73 cannot be Divided by 365, becauſe the

Diviſor is bigger than the Dividend, wherefore bring the 73 *l.* into Shillings, and they make 1460, which divide by the firſt number 365, and the Quote is 4 Shillings for the Anſwer, as you ſee in the Work.

days *l.* *day*
365——73——1
20

365) 1460 (4 *s.*
1460 *Facit* 4 *s. per* day

(0)

Queſt. 10. A Merchant bought 14 pieces of Broad-cloth, each piece containing 28 Yards, for which he gave after the rate of 13 *s.* 6 ½ *d. per* yard, now I deſire to know how much he gave for the 14 pieces at that rate?

Firſt, Find out how many yards are in the 14 pieces, which you will do if you Multiply the 14 pieces by 28 (the number of yards in a piece) and it makes 392; then ſay, If 1 yard coſt 13 *s.* 6½ *d.* what will 392 yards coſt? Work as followeth, and the Anſwer you will find to be 127400 half-pence, which reduced make 265 *l.* 8 *s.* 4 *d.* For after you have multiplied your ſecond and third Numbers together, the product is 127400, which (according to the ſeventh Rule) ſhould be divided by the firſt Number, but the firſt Number is 1, which neither Multiplieth nor Divideth, and therefore the Quotient or fourth Number is the ſame with the product of the ſecond and third, which is in half-pence, becauſe the ſecond Number was ſo reduced. See the Work as followeth.

28
14

112
28

392 *yards in the* 14 *pieces.*

yd *s.* *d.* *yds*
If 1 *coſt* 13—6½ *what will* 392 *coſt ?*
12 325 *the ſecond number.*

32 1960
13 714
1176
162 2|0) *l.* *s.* *d.*
2 24) 127400 (530|8 (265—8—4

half-pen. 325 120 4

74 13
72 12

200 10
192 10

(8) *ſhillings*

l. *s.* *d.* *Rem.* (8) ½ *pence*, or 4 *d.*
Facit 265—8—4

Queſt. A Draper bought 420 *yds* of Broad-cloath, and gave for it after the rate of 14 *s.* 10 *d.* ¾ *per* Ell *Engliſh*, now I demand how much he paid for the whole at that rate?

Bring your Ell into quarters, and your given Yards into quarters, the Ell is 5 quarters, and in 420 Yards are 1680 quarters, then ſay, If 5 quarters coſt 14 *s.* 10 ¾ *d.* (or 715 *farthings*) what will 1680 quarters coſt? *Facit* 250 *l.* 5 *s.* 0 *d.* See the Operation.

1 *Ell*

```
             Ell                     Yards.
              1                        420
              5                          4
            -----                   ------
            5 qrs.                  1680 qrs
      qrs.    s.           d.          qrs.
   If 5 ——— 14 ——————— 10 3/4 ——— 1680
             12                        715
          -------                  -------
             28                       8400
             15                      1680
        --------                   11760
            178 d.             ——— ——— 96|0)        l.
              4                5) 1201200 (24024|0 (250
          -------                 ......     ...
            715 qrs.              10        192
                                 -----     ------
                                  20        482
                                  20        480
                               -------    ------
                                   12     48)240(5 s.
                                   10        240
                                  -----    -------
                                   20        (0)
                                   20
       l.   s.  d.                ----
Facit 250—5—0                      (0)
```

Queſt. 12. A Draper bought of a Merchant 50 pieces of Kerſeys, each piece containing 34 Ells *Flemiſh*, (the Ell *Flemiſh* being 3 quarters of a yard) to pay after the rate of 8 *s.* 4 *d. per* Ell *Engliſh*, I demand how muce the 50 pieces coſt him at that rate?

Firſt, Find how many Ells *Flemiſh* are in the 50 pieces by multiplying 50 by 34, the product is 1700, which bring into quarters by 3, it makes 5100 quarters, then proceed, as in the laſt Queſtion, and the Anſwer you will find to be 102000 pence, or 425 *l.* Behold the Operation, as followeth.

If

```
 s.   d.             34
 8 —— 4              50
12                 ————
————               1700 Ell's Flemiſh
100 d.                3
                   ————
                   5100 qrs

   qrs.     d.     qrs.
If 5 ——— 100 ——— 5100
                   100
          ——————————— 24|0) d.
          5) 510000 (10200|0 (425 l.
             ......       ..
              5          96
           ——————      ——————
   l.        10          60
             10          48
           ——————      ——————
            (000)        120
                         120
Facit 425 l.            ————
                        (00)
```

Queſt. 13. A Goldſmith bought a Wedge of Gold which weighed 14 *l.* 3 *oz.* 8 *p.w.* for the Sum of 514 *l.* 4 *s.* I demand what it ſtood him in *per* Ounce? Anſwer, 60 Shillings, or 3 *l.* See the Work.

```
    l.      oz.      p.w.        l.         s.    oz.
If 14 ———— 3 ———— 8 ———— 514 ———— 4 ———— 1
   12                         20 ſhillings       20
 ————                       ————————           ————
   31                      10284 ſhillings      20 p.w.
   14                         20 p.w.
 ————                   ———————————— 2|0)
  171 oz.         3428) 205680 (6|0 (3 l.
   20                     ..   6
 ——————                  20568 ————     s.     l.
 3428 p.w.              ——————  (0) Facit 60 or 3.
                          (0)
```

Queſt. 14. A Grocer bought 4 *hhds* of Sugar, each weighing neat 6 *C.* 2 *qrs.* 14 *l.* which coſt him 2 *l.* 8 *s.* 6 *d. per C.* I demand the value of the 4 *hhds* at that rate?

Firſt, Find the weight of the 4 *hhds*, which you may do by reducing the weight of one of them into pounds, and Multiply them by 4 (the number of *hhds*) and they make 2968 *l.* then ſay, If 1 *C.* or 112 *l.* coſt 2 *l.* 8 *s.* 6 *d.* what will 2968 *l.* coſt? *Facit* 64 *l.* 5 *s.* 3 *d.* As by the Operation.

```
                                              C    qrs.   l.
                                              6————2————14
                                              4
                                            ————
                                             26
                                             28
                                            —————
    l.   l.  s.  d.       l.                 212
If 112—2—8—06——2968                           53
        20               582                —————
     ————            ————                   742 l. in 1 hhd
        48              5936                  4 hogſheads
        12             23744                —————
     ————             14840                 2968 l. in 4 hhds
       102            ————————12)             2|0)
        48    112) 1727376 (15423 (128|5 (64 l.
     ————          .....     ...     ..
       582          112       12     12
                   ————      ————   ————
                    607       34      8
                    560       24      8
                   ————      ————   ————
                    473      102   (5) ſhillings
                    448       96
                   ————      ————
                    257       03
                    224       60
                   ————      ————
                    336      (3) pence
                   ————               l.  s.  d.
                    (0)      Facit    64—5—3     Queſt.
```

Queſt. 15. A Draper bought of a Merchant 8 packs of Cloth, each pack containing 4 parcels, and each parcel 10 pieces, and in each piece 26 yards, and gave after the rate of 4 *l.* 16 *s.* for 6 yards, now I deſire to know how much he gave for the whole? *Anſwer*, 6656 *l.*

First, Find out how many yards there were in the 8 packs, as by the following Work you will find there are 8320 yards; then ſay, If 6 yards coſt 4 *l.* 16 *s.* what will 8320 yards coſt, *&c.*

```
                                               8 packs
                                               4
                                              ----
                                               32 parcels
                                               10
                                              ----
                                               320 pieces
     yds  l.   s.   yds                        26
If   6—4—16—8320                            ----
          20         96                        1920
     ---------------------                     640
          96       49920                      -----
                   74880                       8320 yds
                  ----------   2|0)     l.
              6)  798720    (13312|0(6656
                  ••••••     ••••
                  6          12
                 ----       ----
                  19         13
                  18         12
                  ----      ----
                   18         11
                   18         10
                   ----      ----
                    7         12
                    6         12
                   ----      ----
                    12        (0)
                    12
Facit 6656 l.      ----
                    (0)
```

By this time the Learner is (I ſuppoſe) well exerciſed in the Practick and Theorick of the Rule of Three Direct. but at his leiſure he may look over the following Queſtions, whoſe Anſwers are given; but the operation purpoſely omitted as a Touchſtone for the Learner thereby to try his Ability in what hath been delivered in the former Rules.

Queſt. 16. If 24 *l.* of Raiſins coſt 6 *s.* 6 *d.* what will 18 Frails coſt, each weighing Neat 3 *qrs*. 18. *l.* *Anſwer*, 24 *l.* 17 s. 3 *d.*

Queſt. 17. If an Ounce of Silver be worth 5 ſhillings, what is the price of 14 Ingots, each Ingot weighing 7 *l.* 5 *oz.* 10. *p.w.* *Anſwer*, 313 *l.* 5 *s.*

Queſt. 18. If a piece of Cloth coſt 10 *l.* 16 *s.* 8 *d.* I demand how many Ells *Engliſh* there are in the ſame, when the Ell at that rate is worth 8 *s.* 4 *d.*? *Anſwer*, 26 Ells *Engliſh*.

Queſt. 19. A Factor bought 84 pieces of Stuffs, which coſt him in all 537 *l.* 12 *s.* at 5 *s.* 4 *d.* *per* yard, I demand how many Yards there were in all, and how many Ells *Engliſh* were contained in a piece of the ſame? *Anſwer*, 2016 Yards in all, and 19 $\frac{1}{5}$ Ells *Engliſh per* piece.

Queſt. 20. A Draper bought 242 Yards of Broadcloth, which coſt him in all 254 *l.* 10 *s.* for 86 Yards of which he gave after the rate of 21 *s.* 4 *d.* *per* yard, I demand how many he gave *per* yard for the remainder? *Anſwer*, 20 *s.* 10 *d.* $\frac{64}{156}$ *per* yard.

Queſt. 21. A Factor bought a certain quantity of Serge and Shalloon, which together coſt him 226 *l.* 14 *s.* 10 *d.* the quantity of Serge he bought was 48 yards at 3 *s.* 4 *d.* *per* yard, and for every two yards of Serge he had 5 yards of Shalloon, I demand how many yards of Shalloon he had, and how much the Shalloon coſt him *per* yard? *Anſwer*, 120 yards of Shalloon at 1 *l.* 16 *s.* 5 $\frac{58}{120}$ *d.* *per.* yard.

Queſt. 22. An Oyl-man bought 3 Tun of Oyl, which coſt him 151 *l.* 14 *s.* and it ſo chanced that it leaked out 85 gallons, but he is minded to ſell it again, ſo as that he may be no loſer by it, I demand how he muſt ſell it per Gallon? *Anſwer*, at 4 *s.* $6\frac{174}{671}$ *d. per* Gallon.

Queſt. 23. Bought 6 packs of Cloth, each pack containing 12 Cloths, which at 8 *s.* 4 *d. per Ell Flemiſh* coſt 1080 *l.* I demand how many yards there were in each Cloth? *Anſwer* 27 yards in each Cloth.

Queſt, 24. A Gentleman hath 536 *l. per annum*, and his Expences are one day with another 18 *s.* 10 *d.* 3 *qrs.* I deſire to know how much he layeth up at the years end? *Anſwer*, 191 *l* 3 *s.* 0 *d.* 1 *qr.*

Queſt. 25. A Gentleman expendeth daily one day with another 27 *s.* 10 $\frac{1}{2}$ *d.* and at the years end layeth up 340 *l.* I demand how much is his Yearly Income? *Anſwer*, 848 *l.* 14 *s.* $4\frac{1}{2}$ *d.*

Queſt. 26. If I ſell 14 yards for 10 *l.* 10. *s.* 00 *d.* how many Ells *Flemiſh* ſhall I ſell for 283 *l.* 17 *s.* 06 *d.* at that rate? *Anſwer*, $504\frac{2}{3}$ Ells *Flemiſh*.

Queſt. 27. If 100 *l.* in 12 Months gain 6 *l.* Intereſt, how much will 75 *l.* gain in the ſame time, and at the ſame rate? *Anſwer*, 4 *l* 10 *s.*

Queſt. 28. If 100 *l.* in 12 Months gain 6 *l.* Intereſt, how much will it gain in 7 Months at that rate? *Anſwer*, 3 *l.* 10 *s.*

Queſt. 29. A certain Uſurer put out 75 *l.* for 12 Months, and received Principal and Intereſt 81 *l.* I demand what rate *per Cent.* he received Intereſt? *Anſwer*, 8 *l prr Cent.*

Queſt. 30. A Grocer bought 2 Cheſts of Sugar, the one weighed Neat 17 *C.* 3 *qrs.* 14 *l.* at 2 l. 6 *s.* 8 *d. per C.* the other weighed Neat 18 *C.* 1 *qr.* 21 *l.* at $4\frac{1}{2}$*d. per l.* which he mingleth together, now I deſire to know how much a *C.* weight of this mixture is worth? *Anſwer*, 2 *l.* 4 *s.* 3 *d.* $2\frac{1078}{4067}$ *qrs.*

Queſt. 31. Two Men, *viz.* *A* and *B*, departed both from one place, the one goes Eaſt, and the other Weſt, the one Travelleth 4 miles a day, the other 5 miles a day, how far are they diſtant the 9th day after their departure? *Anſwer* 81 Miles.

Queſt. 12. *A* flying every Day 40 miles is purſued the 4th Day after by *B*, poſting 50 miles a Day, now the Queſtion is in how many Days, and after how many miles Travel will *A* be overtaken?

More's Arithm. chap. 7. *ex.* 35.

Anſwer, *B* overtakes him in 12 Days, when they have travelled 600 miles.

11. The general Effect of the Rule of Three Direct, is contained in the definition of the ſame, that is, to find a fourth Number in proportion conſiſting of two equal Reaſons as hath been fully ſhewn in all the foregoing Examples.

The ſecond Effect is, by the price or value of one thing to find the price or value of many things of the like kind.

The third Effect is, by the price or value of many things to find the price of one, or by the price of many things (the ſaid price being 1) to find the price of many things of like kind.

The fourth Effect is, by the price or value of many things, to find the price or value of many things of like kind.

The fifth Effect is, thereby to reduce any Number of Moneys, Weight, or Meaſure, the one ſort into the other, as in the Rules of Reduction contained in the Eighth Chapter foregoing. Examples of its various Effects have been already anſwered.

12. The Rule of 3 Direct is thus proved, *viz.* Multiply the firſt Number by the fourth, and note the Product, then multiply the ſecond Number by the third, and if this Product is equal to the Product of the firſt and fourth, then the work is rightly performed, otherwiſe it is erroneous.

The Proof of the Rule of Three Direct.

So the firſt Queſtion of this Chapter (whoſe Anſwer or fourth Number we found to be 18 *s.*) is thus proved, *viz.* the firſt Number is 4, which multiplied by 18 (the fourth) produceth 72. And the ſecond and third Numbers are 12 and 6, which multiplied together produce 72, equal to the Product of the firſt and fourth, and therefore I conclude the Work to be rightly performed.

Always obſerving, that if any thing remain after you have divided the product of the ſecond and third numbers by the firſt, ſuch remainder in proving the ſame, muſt be added to the product of the firſt and fourth Numbers, whoſe Sum will be equal to the product of the ſecond and third, (the ſecond number being of the ſame denomination with the fourth, and the firſt of the ſame denomination with the third.)

So the fourth Queſtion of this Chapter being again repeated, *viz.* If 14 *l.* of Tobacco coſt 27 *s.* what will 478 *l.* coſt at that rate? The Anſwer (or fourth number) was 46 *l.* 01 *s.* 10 *d.* 1 *qr.* $\frac{2}{14}$, which is thus proved, *viz.* bring the fourth number into farthings, and it makes 44249, which multiplied by the firſt number 14, produceth 619488 (the ſecond which remaineth being added thereto) then (becauſe I reduce my fourth number into farthings,) I reduce my ſecond (*viz.* 27 *s.*) into farthings, and they are 1296, which multiplied by the third number 478, their product is 619488 equal to the product of the firſt and fourth Numbers. Wherefore I conclude the Operation to be true. This is an infallible way to prove the *Rule of Three Direct*, and it is deduced from the 12*th Section* of the 9*th Chapter* of this Book.

Thus much concerning *The Single Rule of Three Direct*, and I queſtion not but, by this time the Learner is ſufficiently qualified to reſolve any Queſtion pertinent to this Rule, not relying upon Fractions, or *Geometrical Magnitudes.* Thoſe that are deſirous to ſee the Demonſtration of this Rule, let them read the ſixth Chapter of (the Ingenious) Mr. *Kerſey*'s Appendix to *Wingate*'s Arithmetick. Or the ſixth Chapter of Mr. *Oughtred*'s (incomparable) *Clavis Mathematicæ*: By both which Authors this Rule is largely demonſtrated, being grounded upon the 19*th Prop.* of the 7*th*, and the 19*th Prop.* of the 9*th* of *Euclid. Elem.*

CHAP. XI.

The Single Rule of Three Inverſe.

1. THe Golden Rule, or Rule of 3 Inverſe, is when there are 3 *Numbers* given to find a fourth, in ſuch proportion to the 3 given Numbers, ſo as the 4th proceeds from the 2d, according to the ſame Rate, Reaſon, or Proportion that the firſt proceeds from the third, or the Proportion is,

As the third Number is in proportion to the ſecond, ſo is the firſt to the fourth.

Alſted. Math. lib. 2 *cap.* 14.

So if the 3 numbers given were 8, 12, and 16, and it were required to find a fourth number in an inverted proportion to theſe, I ſay, that as 16 (the third *Number*) is the double of the firſt Term or *Number* (8) ſo muſt 12 (the ſecond *Number*) be the double of the fourth ; ſo will you find the fourth *Term* or *Number* to be 6. And as in the *Rule of* 3 *Direct*, you multiply the ſecond and third together, and divide their Product for a forth Proportional *Number*.

2. In the *Rule of* 3 *Inverſe*, you muſt Multiply the ſecond term by the firſt (or firſt term by the ſecond) and divide the Product thereof by the third term, ſo the Quotient will give you the 4*th* term ſought in an Inverted *Proportion*. The ſame order being obſerved in this *Rule*, as in the *Rule of* 3 *Direct*, for placing and diſpoſing of the given *Numbers*, and after your *Numbers* are placed in order, that you may know whether your Queſtion be to be reſolved by the *Rule Direct* or *Inverſe*, obſerve the general Rule following.

3. When your Queſtion is ſtated, and your *Numbers* orderly diſpoſed, Conſider in the firſt place whether the fourth *Term* or *Number* ſought, ought to be more or leſs than the ſecond *Term* ; which you may eaſily do : And if it is required to be more, or greater than the ſecond *Term*, then the leſſer *Extream* muſt be your Diviſor ; but if it require leſs, then the biggeſt *Ex-*

tream muſt be your Diviſor (in this Caſe, the firſt and third Numbers are called *Extreams* in reſpect of the ſecond) and havivg found out your Diviſor, you may know whether your Queſtion belong to the Rule *Direct* or *Inverſe*; for if the third term be your Diviſor, then it is *Inverſe*, but if the firſt term be your Diviſor, then it is a *Direct* Rule. As in the following Queſtions.

Queſt. 1. If 8 Labourers can do a certain piece of Work in 12 Days, in how many Days will 16 Labourers do the ſame? *Anſwer*, in 6 Days.

Having placed the Numbers according to the *6th* Rule of the *10th* Chapter, I conſider that if 8 Men can finiſh the Work in 12 Days; 16 Men will do it in leſſer (or fewer Days than 12,) therefore the biggeſt Extream muſt be the Diviſor, which is 16, and therefore it is the Rule of 3 *Inverſe*, wherefore I Multiply the firſt and ſecond Numbers together, *viz.* 8 by 12, and their Product is 96, which divided by 16, Quotes 6 Days for the *Anſwer*, and in ſo many Days will 16 Labourers perform a piece of Work, when 8 can do it in 12 Days.

lab. *days.* *lab.*
8——12——16
8
——
16) *96* (*6 days*
96
——
(0)
Ftcit 6 days.

Queſt. 2. If when the Meaſure (*viz.* a peck) of Wheat coſt 2 ſhillings, the penny Loaf weighed (according to the Standard, Statute, or Law of *England*) 8 Ounces, I demand how much it will weigh when the peck is worth 1 *s.* 6 *d.* according to the ſame rate or proportion? *Anſwer*, 10 *oz.* 13 *p.w.* 8 *gr.*

Having placed and reduced the given Numbers according to the *6* and *9* Rules of the *10th* Chapter, I conſider, that at 1 *s.* 6 *d. per* peck, the penny Loaf will weigh more than at 2 *s. per* peck; for as the price decreaſeth, the weight increaſeth, and as the price increaſeth, ſo the weight diminiſheth; wherefore becauſe the firſt term requireth more than the ſecond, the leſſer Extream muſt be the Diviſor, 1 *s.* 6 *d.* or 18 *d.* and having finiſhed the Work, I find the *Anſwer* to be 10 *oz.*

13 *p.w.* 8 *gr.* and ſo much will the penny Loaf weigh when the peck of Wheat is worth 1 *s.* 6 *d.* according to the given rate of 8 Ounces, when the peck is worth 2 ſhillings, the work is plain in the following Operation.

```
 s.            oz.            s.           d.
 2 ——————————— 8 ——————————— 1 —————————— 6
12             24            12
——            ————           ——
24             32            18
               16
          —————— oz. p.w. gr.
      18) 192 (10—13—8
           ..
           18
          ————
          (12)
           20
          ———— p. w.
      18) 240 (13
           ..
           18
          ————
           60
           54
          ————
           (6)
           24
          ————
           24
           12
          ——————
      18) 144 (8 gr.
          144
          ————
           (0)
```

Queſt. 3. How many pieces of Money or Merchandiſe at 20 *s.* *per* piece are to be given or received for 240 pieces, the value or price of every piece being 12 ſhillings? *Anſwer*, 144. For if 12 *s.* require 240 pieces, then 20 ſhillings will require leſs; therefore the biggeſt Extream muſt be the Diviſor, which is the third number, *&c.* See the Work.

```
      s.  pieces  s.
   If 12——240——20
          12
         ————
         480
        240
         ————
2|0) 288|0 (144 pieces at 20 s. per piece.
       2
       ——
        8
        8
       ——
        8
        8
       ——
       (0)
```

Queſt. 4. How many Yards of 3 quarters broad are required to double, or be equal in meaſure to 30 yards, that are 5 quarters broad? *Anſwer*, 50 Yards: For ſay, if 5 quarters wide require 30 Yards long, what length will three quarters broad require? Here I conſider that three quarters broad will require more Yards than 30, for the narrower the Cloth is, the more in length will go to make equal meaſure with a broader piece.

```
qrs    long    qrs
 5 —— 30 —— 3
        5
      ————
 3) 150 (50 yds
     ..
     15
    ————
     (0)
```

Queſt. 5. At the Requeſt of a Friend, I lent him 200 *l.* for 12 Months, promiſing to do me the like Courteſie at my Neceſſity; but when I came to requeſt it of him, he could let me have but 150 *l.* now I deſire to know how long I may keep this Money to make plenary ſatisfaction for my former kindneſs to my Friend? *Anſwer*, 16 Months. I ſay, If 200 *l.* require 12 Months, what will 150 *l.* require? 150 *l.* will require more time than 12 Months, therefore the leſſer *Extream* (*viz.* 150) muſt be the Diviſor, Multiply and divide, and you will find the fourth inverted Proportional to be 16, and ſo many months I ought to keep the 150 *l.* for ſatisfaction.

Queſt, 6. If for 34 *s.* I have 1200 *l.* weight carried 36 miles, how many miles ſhall 1800 *l.* be carried for the ſame Money? *Anſwer*, 24 miles.

Queſt. 7. If for 24 *s.* I have 1200 *l.* carried 36 miles, how many pound weight ſhall I have carried 24 miles for the ſame Money? *Anſwer*, 1800 pound weight.

Queſt. 8. If 100 Workmen in 12 Days finiſh a piece of Work or Service, how many Workmen are ſufficient to do the ſame in 3 Days? *Anſwer*, 400 Workmen.

Queſt. 9. A Colonel is beſieged in a Town in which are 1000 Soldiers, with proviſion of Victuals only for 3 months, the Queſtion is, how many of his Soldiers muſt he diſmiſs, that his Victuals may laſt the remaining Soldiers 6 months? *Anſwer*, 500 he muſt keep, and diſmiſs as many.

Queſt. 10. If Wine worth 20 *l.* is ſufficient for the Ordinary of 100 Men, when the Tun is ſold for 30 *l.* how many Men will the ſame 20 pounds worth ſuffice when the Tun is worth 24 *l.*? *Anſwer*, 125 Men.

Queſt. 11. How much Pluſh is ſufficient to line a Cloak, which hath in it 4 yards of 7 quarters wide, when the Pluſh is but 3 quarters wide? *Anſwer*, $9\frac{1}{3}$ yards of Pluſh.

Queſt. 12. How many yards of Canvas that is Ell wide, will be ſufficient to line 20 yards of Say, that is 3 quarters wide? *Anſwer*, 12 yards.

Queſt, 13. How many yards of Matting that is two foot wide, will cover a Floor that is 24 foot long, and 20 foot broad? *Anſwer*, 240 foot.

Queſt. 14. A Regiment of Soldiers conſiſting of 1000, are to have new Coats, and each Coat to contain 2 yards, 2 quarters of Cloth, that is 5 quarters wide, and they are to be lined with Shalloon that is 3 quarters wide, I demand how many yards of Shalloon will line them? *Anſwer*, $16666\frac{2}{3}$ quarters of yards, or $4166\frac{2}{3}$ yards.

Queſt. 15. A Meſſenger makes a Journey in 24 Days, when the Day is 12 Hours long, I deſire to know in how many Days he will go the ſame when the Day is 16 Hours long? *Anſwer*, in 18 Days.

Queſt. 16. Borrowed of my Friend 64 *l.* for 8 Months, and he hath occaſion another time to borrow of me for 12 Months, I deſire to know how much I muſt lend to make good his former kindneſs to me? *Anſwer*, 42 *l.* 13 *s.* 5 *d.*

3. The general Effect of the Rule of 3 *Inverſe* is contained in the definition of the ſame, that is, to find a fourth term in a Reciprocal Proportion, inverted to the Proportion given:

The ſecond Effect, is, by two prices, or values of two ſeveral pieces of Money or Merchandize known, to find how many pieces of the one price is to be given for ſo many of the other. And conſequently to reduce and exchange one ſort of Money, or Merchandize into another. Or contrariwiſe, to find the price unknown of any piece given to exchange in Reciprocal Proportion.

The third Effect, is, by two differing prices of a Meaſure of Wheat bought or ſold, and the weight of the Loaf of Bread, made anſwerable to one of the prices of the Meaſure given, to find out the weight of the ſame Loaf anſwerable to the other price of the ſaid Meaſure given. Or contrariwiſe by the two ſeveral weights of the ſame prized Loaf, and the price of the Meaſure of Wheat anſwerable to one of theſe Weights given, to find out the other price of the Meaſure anſwerable to the other Weight of the ſame Loaf.

The fourth Effect, is, by two Lengths, and one Breadth of two Rectangular Planes known, to find out another Breadth unknown. Or by two Breadths and one Length given, to find out another Length unknown in an inverted Proportion.

The fifth Effect, is, by double Time and a capital Sum of Money borrowed or lent, to find out another capital Sum anſwerable to one of the given Times, or otherwiſe, by two Capital Sums, and a time anſwerable to one of them given to find out a time anſwerable to the other capital Sum in Reciprocal Reaſon.

The Sixth Effect is, by two differing Weights of Carriage, and the diſtance of the places in Miles or in Leagues given, to find another diſtance in Miles, anſwerable to the ſame price of payment, Or otherwiſe by two diſtances in Miles, and the weight anſwerable to one of the diſtances (being carried for a certain price) to find out the weight anſwerable to the other diſtance for the ſame price.

The Seventh Effect is by double Workmen, and the time anſwerable to one of the numbers of Workmen given, to find out the time anſwerable to the other number of Workmen, in the performance of any work or ſervice. Or contrariwiſe, by double time, and the Workmen anſwerable to one of thoſe times given, to find out the number of Workmen anſwerable to the other time, in the performance of any Work or Service.

Alſo by a double price of Proviſion, and the number of Men, or other Creatures nouriſhed for a certain time, anſwerable to one of the prices of Proviſion given, to find out another Number of Men or other Creatures anſwerable to the other price of the proviſion for the ſame time. Or contrariwiſe, by two uumbers of Men or other Creatures nouriſhed, and one price of proviſion anſwerable to one of the numbers of Creatures given, to find out the other price of the ſame proviſion anſwerable to the other number of Creatures, both being ſuppoſed to be nouriſhed for the ſame, *&c.* As in the foregoing Examples is fully declared.

To prove the Operation of the Rule of 3 Inverſe, Multiply the third and fourth terms together, and note their product; and Multiply the firſt and ſecond together, and if their product is equal to the product of the third and fourth, then is the Work truly wrought, but if it falleth out otherwiſe, then it is erroneous.

As in the firſt Queſtion of this Chapter, 16 (the third *number*) being Multiplied by 6 (the fourth *number*) the product is 96, and the product of 8 (the firſt number) Multiplied by 12 (the ſecond number) is 96, equal to the firſt product, which proves the work to be right.

And Note, that if in Diviſion any thing remain, ſuch remainder muſt be added to the product of the third and fourth terms, and if the Sum be equal to the product of the firſt and ſecond (the Homogeneal Terms being of one Denomination) the work is right.

CHAP XII.

The Double Rule of Three Direct.

WE have already delivered the *Rules of Single Proportion*, and we come now to lay down the *Rules* of *Plural Proportion.*

1. *Plural Proportion*, is when more Operations in the Rule of Three than one, are required before a Solution can be given to the Queſtion propounded. Therefore in Queſtions that require Plurality in *Proportion*, there are always given more than three Numbers.

2. When there are given 5 numbers, and a ſixth is required in proportion thereunto, then this ſixth proportion is ſaid to be found out by the *double Rule of Three*, as in the Queſtion following, *viz.*

If 100 *l.* in 12 Months gain 6 *l*, Intereſt, how much will 75 *l.* gain in 9 Months?

3. Queſtions in the *Double Rule of Three* may be reſolved either by two *Single Rules of Three*, or by one *Single Rule of Three*, Compounded of the Five given Numbers.

4. The *Double Rule of Three* is either *Direct*, or elſe *Inverſe*.

5. The *Double Rule of Three Direct*, is, when unto 5 given Numbers, a ſixth proportional may be found out by two Single Rules of Three *Direct*.

6. The Five given Numbers in the *Double Rule of Three*

Three conſiſt of 2 parts, *viz.* Firſt, a Suppoſition, and Secondly, of a Demand; the Suppoſition is contained in the three firſt of the five given Numbers, and the Demand lies in the two laſt; as in the Example of the ſecond Rule of this Chapter, *viz.* If 100 *l.* in 12 Months gain 6 *l.* Intereſt, what will 75 *l.* gain in 9 Months? Here the Suppoſition is expreſſed in 100, 12, and 6; for it is ſaid, if (or ſuppoſe) 100 *l.* in 12 Months gain 6 *l.* Intereſt, and the Demand lyeth in 75 and 9; for it is demanded how much 75 *l.* will gain in 9 Months?

7. When your Queſtion is ſtated, the next thing will be to diſpoſe of the given Numbers in due order and place, as a preparative for Reſolution; which that you may do, Firſt, obſerve which of the given Numbers in the Suppoſition is of the ſame Denomination with the Number required, for that muſt be the ſecond number (in the firſt operation) of the ſingle Rule of 3, and one of the other Numbers in the Suppoſition (it matters not which) muſt be the firſt Number, and that Number in the Demand which is of the ſame Denomination with the firſt, muſt be the third number, which three Numbers being thus placed, will make one perfect Queſtion in the ſingle Rule of Three, as in the forementioned Example: Firſt, I conſider that the Number required in the Queſtion is the Intereſt or Gain of 75 *l.* therefore that number in the Suppoſition which hath the ſame name (*viz.* 6 *l.* which is the Intereſt or Gain of 100 *l.*) muſt be the ſecond Number in the firſt Operation, and either 100 or 12 (it matters not which) muſt be the firſt Number; but I will take 100, and then for the third Number, I put that Number in the Demand, which hath the ſame Denomination with 100, which is 75, (for they both ſignifie Pounds principal) and then the Numbers will ſtand as you ſee in the Margent.

100——*6*——75

But if I had for the firſt *number* put the other *number* in the Suppoſition, *viz.* 12, which ſignifieth 12 months, then the third number muſt have been 9, which is that number in the Demand which hath the ſame Denomination with the firſt, *viz.* 9 months, and then they will ſtand as in the Margent.

12——*6*——9

There yet remain two numbers to be diſpoſed of, and thoſe are, one in the Suppoſition, and another in the Demand; that which is of the Suppoſition I place under the firſt of the three numbers, and the other which is in the Demand I place under the third number, and then 2 of the terms in the Suppoſition will ſtand (one over the other) in the firſt place, and the 2 terms in the Demand will ſtand (one over the other) in the third place, as in the Margent.

100——*6*——75
12 9

Or thus,

12——*6*—— 9
100 75

8. Having diſpoſed, or ordered the numbers given according to the laſt Rule, we may proceed to a reſolution, and firſt I work with the three uppermoſt numbers, which according to the firſt diſpoſition are 100, *6*, and 75, which is as uuch as to ſay, If 100 *l.* require *6 l.* (Intereſt) how mnch will 75 *l.* require? which by the third Rule of the eleventh Chapter I find to be *Direct*, and by the 7th and 8th Rules of the 10th Chapter, I find the fourth *Proportional Number* to be 4 *l.* 10 *s.* ſo that by the foregoing ſingle Queſtion I have diſcovered how much Intereſt 75 *l.* will gain in 12 months, the operation whereof followeth on the left hand under the letter *A*; and having diſcovered how much 75 *l.* will gain in 12 months, we may by another queſtion eaſily diſcover how much it will gain in 9 months, for this fourth number (thus found) I put in the middle between the two loweſt numbers of the five, after they are placed according to the ſeventh Rule of this Chapter; and then it will be a ſecond number, in another Queſtion in the Rule of Three,

m. l. s. m.
the numbers being 12.—4—10—9 the firſt and third

numbers being of one Denomination, *viz.* both months, and may be thus expreſſed, If 12 months require 4 *l.* 10 *s.* Intereſt, what will 9 months require? And by the third Rule of the 11th Chapter I find it to be the *Direct* Rule, and by working according to the directions laid down in the 7, 8, and 9 Rules of the 10th Chapter, I find the fourth *Proportional Number* to the laſt ſingle Queſtion to be 03 *l.* 07 *s.* 06 *d.* which is the 6th *Proportional Number* to the 5 given numbers, and is the Anſwer to the general Queſtion. The work of the laſt ſingle Queſtion is expreſſed on the right ſide of the page under the letter *B*, as followeth;

100——6——75

A 12

l. l. l.

If 100——6——75
75

30
42

l. *s.*
1|00) 4|50 (4--10
4

Rem. (50)
Mult. 20

1|00) 10|00 (10 *s*

l. *s.*
Facit 4——10

9 B

Then ſay,

m. *l.* *s.* *m.*
If 12——4——10——9
20

90 *ſhillings*
12

180
90

1080 *pence*
9

12) 2|0 *l.* *s.* *d.*
129720 (810 (6|7 (3—7—6
6

96 72
(7 *s.*)

12 90
12 84

(0) (6) *pence*

l. *s.* *d.*
Facit 3——7——6

So that by the foregoing Operation I conclude that if 100 *l.* in 12 months gain 6 *l.* Intereſt, 75 *l.* will gain 3 *l.* 7 *s.* 6 *d.* in 9 months after the ſame rate.

The Anſwer would have been the ſame if the 5 given *numbers* had been ordered according to the ſecond method, *viz* as you ſee in the Margent.

12—6—9
100 75

For firſt, I ſay, if 12 months gain 6 *l.* what will 9 months gain? This Queſtion I find to be *Direct* by the 3*d* Rule of the 11*th* Chapter, and by the 7 and 8 Rules of the 10*th* Chapter, I find the fourth proportional Number to theſe three to be 4 *l.* 10 *s.*

Thus have I found out what is the Intereſt of 100 *l.* for 9 months, and I am now to find the Intereſt of 75 *l.* for 9 months; to effect which, I make this 4*th* number (found as before) to be my ſecond number in the next Queſtion, and ſay, If 100 *l.* require 4 *l.* 10 *s.* what will 75 *l.* require? This Queſtion I find (by the ſaid third Rule of the 11*th* Chapter) to be *Direct*, and by the ſaid 7*th*, 8*th*, and 9*th* Rules of the 10*th* Chapter, I find the Anſwer to be as before. *viz* 3 *l.* 7 *s.* 6 *d.*

This Rule hath been ſufficiently explained by the foregoing Example, ſo that the Learner may be able to reſolve the following (or any other) Queſtions pertinent to the *double Rule of* 3 *Direct*, whoſe Anſwers are there given, but the Operation purpoſely omitted to try the Learner's ability in the knowledge of what hath been before delivered.

Queſt. 2. A ſecond Example in this Rule may be as followeth, *viz.* A Carrier receiving 42 ſhillings for the Carriage of 300 weight 150 miles, I demand how much he ought to receive for the Carriage of 7 *C.* 3 *qrs.* 14 *l* 50 miles at that rate? *Anſwer*, 36 *s.* 9 *d.*

Queſt. 3. A Regiment of 936 Soldiers eat up 351 quarters of Wheat in 168 days, I demand how many quarters of Wheat 11232 Soldiers will eat in 56 days at that rate? *Anſwes*, 1404 *qrs.*

Queſt. 4. If 40 Acres of Graſs be mowed by 8 Men in 7 days, how many Acres ſhall be mowed by 24 Men in 28 days? *Anſwer*, 480 Acres

Queſt. 5. If 48 buſhels of Corn (or other Seed) yield 576 buſhels in 1 year, how much will 240 buſhels yield in 6 years at that rate? That is to ſay, if there were Sowed 240 Buſhels every one of the 6 Years? *Anſwer*, 17280 Buſhels.

Queſt. 6. If 40 Shillings is the Wages of 8 Men for 5 days, what ſhall be the Wages of 32 Men for 24 days? *Anſwer*, 768 ſhillings, or 38 *l.* 8 *s.*

Queſt. 7. If 14 Horſes eat 56 buſhels of Provender in 16 days, how many buſhels will 20 Horſes eat in 24 days? *Anſwer*, 120 buſhels.

Queſt. 8. If 8 Cannons in one day, ſpend 48 Barrels of Powder, I demand how many Barrels 24 Cannons will ſpend in 12 days at that rate? *Anſwer*, 1728 Barrels.

Queſt. 9. If in a Family, conſiſting of 7 Perſons, there are drunk out 2 Kilderkins of Beer in 12 days, how many Kilderkins will there be drunk out in 8 days by another Family conſiſting of 14 perſons? *Anſwer*, 48 Gallons, or 2 Kilderkins and 12 Gallons.

Queſt. 10. An Uſurer put 75 *l.* out to receive Intereſt for the ſame, and when it had continued 9 Months, he received for Principal and Intereſt 78 *l.* 7 *s.* 6 *d.* I demand at what rate *per Cent. per Annum*, here ceived Intereſt? *Anſwer*, at 6 *l. per Cent. per Annum.*

CHAP. XIII.

The Double Rule of Three Inverſe.

1. THE *Double Rule of* 3 *Inverſe*, is, when a Queſtion in the Double Rule of 3 is reſolved by 2 ſingle Rules of 3, and one of thoſe ſingle Rules falls out to be *Inverſe*, or requires a fourth number in *Proportion Reciprocal* (for both the Queſtions are never *Inverſe*)

2. In all Queſtions of the Double Rule of 3 (as well *Inverſ.*, as *Direct*) you are in the diſpoſing of the 5

given *numbers*) to obſerve the 7th Rule of the 12th Chapter, and in reſolving of it by two ſingle Rules, obſerve to make choice of your *Numbers* for the firſt and ſecond ſingle Queſtions according to the directions given in the eighth Rule of the ſame Chapter, as in the Example following, *viz.*

Queſt. 1. If 100 *l.* Principal in 12 Months gain 6 *l.* Intereſt, what Principal will gain 3 *l.* 7 *s.* 6 *d.* in 9 Months?

This Queſtion is an Inverſion of the firſt Queſtion of the 12th Chapter, and may ſerve for a proof thereof.

In order to a Reſolution, I diſpoſe of the 5 given *Numbers* according to the 7th Rule of the laſt Chapter, and being ſo diſpoſed, they will ſtand as followeth.

12————100————9
6 l. s. d.
3—7—6.

Or thus,

l. s. d.
6————100————3—7—6.
12 9

Here obſerve, that according to the eighth Rule of the twelfth Chapter, the firſt Queſtion, if you take it from the 5 *Numbers* (as they are ordered or placed firſt) will be, if 12 Months require 100 *l.* principal, what will 9 Months require to make the ſame Intereſt? This (according to the third Rule of the 11th Chapter) is *Inverſe*, and the anſwer will be found (by the 2d Rule of the 11th Chapter) to be 133 *l.* 6 *s.* 8 *d.* the ſecond queſtion then will be, if 6 *l.* Intereſt require 133 *l.* 6 *s.* 8 *d.* principal, how much principal will 3 *l.* 7 *s.* 6 *d.* require? This is a direct Rule, and the anſwer in a direct *proportion* is 75 *l.* See the Work.

Firſt I ſay,

m. *l.* *m.*
If 12——100——9
12
l. *s.* *d.*
9) 1200 (133—6—8
• • •
9
30
27
30
27
(3)
20
9) 60 (6 *s.*
54
(6)
12
9) 72 (8 *d.*
72
(0)

Then I ſay,

```
   l.         l.     s.    d.         l.    s.    d.
If 6————————133————6————8—————————3————7————6
  240         20                   20
 ————        ————                 ————
|1440 d.    2666                   67
              12                   12
           ——————                ——————
            5340                  140
           2666                    67
          ———————                ——————
           32000                  810 d.
             108
         ————————
          320000
         256
        ———————————————— 24|0
144|0) 2592000|0 (1800|0 (75 l.
         144        168
        ——————     ——————
        1152        120
        1152        120
       ——————      ——————
         (0)        (0)
```

So that by the foregoing Work I find that if *6 l.* Intereſt be gained by 100 *l.* in 12 months, 3 *l.* 7 *s.* 6 *d.* will be gained by 75 *l.* in 9 months.

But if the reſolution had been found out by the Numbers as they are ranked in the ſecond place, then the ſecond Queſtion in the ſingle Rule would have been *Inverſe*, and the firſt Queſtion *Direct*, and the concluſion the ſame with the firſt method, *viz.* 75 *l.*

Queſt. 2. If a Regiment conſiſting of 936 Soldiers can eat up 351 quarters of Wheat in 168 days, how many Soldiers will eat up 1404 quarters in 56 days at that rate? *Anſwer.* 11232 Soldiers,

Queſt. 3. If 12 Students in 8 Weeks ſpend 48 *l.* I demand how many Students will ſpend 288 *l.* in 18 Weeks? *Anſwer*, 32 Students.

Queſt. 4. If 48 *l.* ſerve 12 Students 8 Weeks, how many Weeks will 288 *l.* ſerve 4 Students? *Anſwer,* 144 Weeks.

Queſt. 5. If when the Buſhel of Wheat coſt 3 *s.* 4 *d.* the penny Loaf weigheth 12 Ounces, I demand the weight of the Loaf worth 9 *d.* when the Buſhel coſt 10 *s?* *Anſwer,* 36 Ounces.

Queſt. 6. If 48 Pioneers in 12 Days caſt a Trench 24 yards long, how many Pioneers will caſt a Trench 168 yards long in 16 Days? *Anſwer,* 252 Pioneers.

Queſt. 7. If 12 *C.* weight being carried 100 Miles, coſt 5 *l.* 12 *s.* I deſire to know how many *C.* weight may be carried 150 Miles for 12 *l.* 12 *s.* at that rate? *Anſwer,* 18 *C.*

Queſt. 8. If when Wine is worth 30 *l. per Tun,* 20 pounds worth is ſufficient for the ordinary of 100 Men, how many Men will 4 pounds worth ſuffice when it is worth 24 *l. per Tun?* *Anſwer,* 25 Men.

Queſt. 9. If 6 Men in 24 Days Mow 72 Acres, in how many Days will 8 Men Mow 24 Acres? *Anſwer,* in 6 Days.

Queſt. 10. If when the Tun of Wine is worth 30 *l.* 100 Men will be ſatisfied with 20 *l.* worth, I deſire to know what the Tun is worth when 4 *l.* worth will ſatisfie 25 Men at the ſame rate? *Anſwer,* 24 *l. per Tun.*

CHAP. XIV.

The Rule of Three compoſed of Five Numbers.

1. THE *Rule of Three Compoſed,* is, when Queſtions (wherein there are 5 *Numbers* given to find a 6th in proportion thereunto) are reſolved by one ſingle Rule of 3 compoſed of the 5 given *Numbers.*

2 When Queſtions may be performed by the double Rule of 3 Direct, and it is required to reſolve them by the Rule of 3 Compoſed, (firſt, order or rank your Numbers according to the 7th Rule of the 12th Chapter, then)

The Rule is,

Multiply the Terms or (Numbers) that ſtand one over the other, in the firſt place, the one by the other, and make their Product the firſt Term in the Rule of Three Direct, then multiply the Terms that ſtand one over the other, in the third place, and place their Product for the third Term in the Rule of Three Direct, and put the middle Term of the three uppermoſt for a ſecond Term; then having found a fourth Proportional, direct to theſe three, this fourth Proportional ſo found, ſhall be the Anſwer required.

So the firſt Queſtion of the 12*th* Chapter being propoſed, *viz.* If 100 *l.* in 12 Months gain 6 *l.* Intereſt, what will 75 *l.* gain in 9 Months? The Numbers being ranked (or placed) as is there directed and done.

Then I multiply the two firſt Terms, 100 and 12, the one by the other, and their Product is 1200 (for the firſt Term;) then I multiply the two laſt Terms 75 and 9 together, and their Product is 675 for the third Term. Then I ſay, as 1200 is to 6, ſo is 675 to the Anſwea, which by the Rule of Three Direct, will be found to be 3 *l.* 7 *s.* 6 *d.* as was before found.

2. But if the Queſtion be to be anſwered by the double Rule of three Inverſe, then (having placed the five given Terms as before) multiply the lowermoſt Term of the firſt place, by the uppermoſt Term of the third place, and put the Product for the firſt Term; then multiply the uppermoſt Term of the firſt place, by the lowermoſt Term of the third place, and put the Product for the third Term, and put the ſecond Term of the three higheſt Numbers for the middle Term to thoſe two, then if the Inverſe Proportion is found in the uppermoſt three Numbers, the 4*th* Proportional Direct to theſe three ſhall be the Anſwer; ſo the firſt Queſtion of the 13*th* Chapter being ſtated, *viz.* If a 100 *l.* Principal in 12 Months gain 6 *l.* Intereſt, what Principal will gain 3 *l.* 7 *s.* 6 *d.* in 9 Months? State the Numbers as is there directed in the firſt order, *viz.*

12

M.	*l.*	*M.*		
12	100	9		
l.		*l.*	*s.*	*d.*
6		3	7	6

then reduce the 6 *l.* and 3 *l.* 7 *s.* 6 *d.* into pence, the 6 *l.* is 1440 *d.* and 3 *l.* 7 *s.* 6 *d.* is 810 *d.* then Multiply 1440 by 9, the product is 12960 for the firſt term in the Rule of three Direct, and Multiply 810 by 12, the product is 9720 for the third term, then I ſay, As 12960 is to 100 *l.* ſo is 9720 to the Anſwer, *viz.* 75 *l.* as before. But if the terms had been placed after the ſecond order, *viz.*

l.	*l.*	*l.*	*s.*	*d.*
6	100	3	7	6
M.		*M.*		
12		9		

then the Inverſe Proportion is found in the loweſt Numbers, and having Compoſed the Numbers for a ſingle Rule of Three as in the ſecond Rule foregoing, then the Anſwer muſt be found by a ſingle Rule of Three Inverſe; for here it falls out to Multiply 810 by 12 for the firſt Number, and 1440 by 9 for the third Number, and then you muſt ſay, As 9720 is to 100 *l.* ſo is 12960 to the Anſwer, which by Inverſe Proportion will be found to be 75 *l.* as before.

The Queſtions in the 12th and 13th Chapters may ſerve for thy farther Experience.

CHAP. XV.

Single Fellowſhip.

FELLOWSHIP is that Rule of Plural Proportion, whereby we Ballance Accompts depending between divers Perſons having put together a general Stock, ſo that they may every Man have his proportional part of Gain, or ſuſtain his proportional part of Loſs.

2. The Rule of Fellowſhip is either ſingle, or it is double.

3. The ſingle Rule is when the Stocks propounded are Single Numbers without any reſpect or relation to time, each Partner continuing his Money in Stock for the ſame time.

4. In the Single Rule of Fellowſhip, the proportion is as the whole Stock of all the Partners is in proportion to the total Gain or Loſs, ſo is each Man's particular ſhare in the Stock, to his particular ſhare in the Gain or Loſs. Therefore take the Total of all the Stocks for the firſt term in the Rule of Three, and the whole Gain or Loſs for the ſecond Term, and the particular Stock of any one of the Partners for the third Term, then Multiply and Divide according to the 7th Rule of the 9th Chapter, and the 4th proportional Number is the particular Loſs or Gain of him whoſe Stock you made your ſecond Number, wherefore repeat the Rule of Three as often as there are particular Stocks, or Partners in the Queſtion, and the 4th Terms produced upon the ſeveral Operations are the reſpective Gain or Loſs of thoſe particular Stocks given; as in the Examples following.

Queſt. 1. Two Perſons, *viz.* A and B, bought a Tun of Wine for 20 *l.* of which A paid 12 *l.* and B paid 8 *l.* and they gained in the Sale thereof 5 *l.* now I demand each Man's ſhare in the Gains according to his Stock?

First, I find the Sum of their Stocks, by adding them together, *viz.* 12 *l.* and 8 *l.* which are 20 *l.* then according to this Rule, I ſay firſt, If 20 *l.* (the Sum of their Stocks) require 5 *l.* the total Gain, how much will 12 *l.* (the Stock of A) require? Multiply and Divide by the 7th Rule of the ninth Chapter, and the Anſwer is 3 *l.* for the ſhare of A in the Gains;

12
8
———
20 *l.*

gains; then again I ſay, If 20 *l.* require 5 *l.* what will 8 *l.* require? The Anſwer is 2 *l.* which is the *gain* of B. So I conclude that the ſhare of A in the gain is 3 *l.* and the ſhare of B in the gain is 2 *l.* which in all is 5 *l.*

l. l. l.
If 20——5——12
12
——
20) 60 (3 *l.*
60
——
(0)

l. l. l.
If 20——5——8
8
——
20) 40 (2 *l.*

Queſt. 2. Three Merchants, *viz.* A, B, and C, enter upon a joynt Adventure, A put into the common ſtock 78 *l.* B put in 117 *l.* and C put in 234 *l.* and they find (when they make up their Accompts) that they have gained in all 264 *l.* now I deſire to know each Man's particular ſhare in the gains?

Firſt I add their particular ſtocks together, and their Sum is 429 *l.* then ſay, If 429 *l.* gain 264 *l.* what will 78 *l.* gain? and what 117 *l.* and what will 234 *l.* (the Stocks of A, B, and C,) gain? Work by three ſeveral Rules of 3, and you will find that

l.
78
117
234
——
Sum 429

$$\text{The Gain of} \left\{\begin{array}{l}A\\B\\C\end{array}\right\} \text{is} \left\{\begin{array}{r}\text{l.}\\48\\72\\144\end{array}\right.$$

——
Sum 264
——

Queſt. 3. Four Partners, *viz.* A, B, C, and D, between them built a Ship which coſt 1730 *l.* of which A paid 346 *l.* B 519 *l.* C 692 *l.* and D 173 *l.* and her Freight for a certain Voyage is 370 *l.* which is due to the Owners or Builders, I demand each Man's ſhare therein according to his Charge in building her.

Anſwer,

	l.
A	74
B	111
C	148
D	37
Sum	370

Queſt. 4. A, B, and C, enter Partnerſhip for a certain time, A put into the common ſtock 364 *l.* B put in 482 *l.* C put in 500 *l.* and they gained 867 *l.* now I demand each Man's ſhare in the Gain proportionable to his Stock.

Anſwer,

	l.	s.	d.	
A	234	09	3	$\frac{354}{1346}$
B	310	09	5	$\frac{62}{1346}$
C	322	09	3	$\frac{230}{1346}$
Sum	867	00	0	

The Proof of the Rule of Single Fellowſhip.

5. To prove the Rule of *Single Fellowſhip*, add each Man's particular Gain or Loſs together, and if the total Sum is equal to the general Gain or Loſs, then is the Work rightly performed, but otherwiſe it is erroneous. Example, In the firſt Queſtion of this Chapter, the *Anſwer* was, that the Gain of A was 3 *l.* and the Gain of B 2 *l.* which added together make 5 *l.* equal to the total Gain given.

If in finding out the *particular Shares* of the ſeveral *Partners*, any thing remain after Diviſion is ended, ſuch remainders muſt be added together, (they being all Fractions of the ſame Denomination) and their Sum divided by the common Diviſor in each Queſtion (*viz.* the total Stock) and the Quotient add to the *particular Gains*, and then if the total Sum is equal to the total Gain, the Work is right, otherwiſe not.

As in the fourth Queſtion, the Remainders were 354, 62, and 930, which added together make 1346, which divided by 1346, (the Sum of their Stocks) the Quotient is 1 *d.* which I add to the pence, *&c.* and the Sum of their Shares is 867 *l.* equal to the total Gain; whereſore I conclude the Work is right.

CHAP XVI.

Double Fellowſhip.

1. Double Fellowſhip is, when ſeveral Perſons enter into *Partnerſhip* for unequal time, that is, when every Man's *particular* Stock hath a relation to a *particular* time.

2. In the Double Rule of Fellowſhip, multiply each *particular* Stock by its reſpective time, and having added the ſeveral Products together, make their Sum the firſt *Number* (or *Term*) in the Rule of 3, and the total Gain or Loſs the ſecond Number, and the Product of any one's particular Stock by his time, the third *Term*, and the 4th *Number* in *proportion* thereunto is his *particular* Gain or Loſs, whoſe Product of Stock and Time is your third *Number*.

Then repeat (as in Single Fellowſhip) the Rule of 3, as often as there are Products or (Partners) and the 4 *Terms* thereby invented are the *Numbers* required. *Example.*

Queſt 1. A and B enter *Partnerſhip*, A put in 40 *l.* for 3 Months, B put in 75 *l.* for 4 Months, and they gained 70 *l.* now I demand each Man's ſhare in the Gains, proportionable to his Stock and Time? *Anſwer*, A 20 *l.* B 50 *l.*

To reſolve this Queſtion, I firſt multiply the Stock of A, (*viz.* 50 *l.*) by its time (3 Months) and the Product is 120; then I multiply the Stock of B by its time, (*viz.* 75 by 4) and it produceth 300, which I add to the Product of A his Stock and time, and the Sum is 420. Then by the Rule of 3 Direct, I ſay, As 420 (the Sum of the Products) is to 70 (the total Gain) ſo is 120 (the Product of A his Stock and Time) to 20 *l.* (the ſhare of A in the Gains) and is 300 (the Product of B his Stock and Time) to 50 *l.* (the Share of B in the Gains.) And ſo much ought each to have for his ſhare.

	l.		*l.*
	40		75
	3		4
A	120	B	300
			120
		Sum	420

Queſt. 2. A, B, and C make a Stock for 12 Months, A put in at firſt 364 *l.* and 4 Months after that he put in 40 *l.* B put in at firſt 408 *l.* and at the end of 4 Months he took out 86 *l.* C put in at firſt 148 *l.* and 3 Months after he put in 86 *l.* more, and 5 Months after that he put in 100 *l.* more, and at the end of 12 Months, their Gain is found to be 1436 *l.* I deſire to know each Man's Share in the Gains according to his Stock and Time?

Firſt, I conſider that the whole Time of their Partnerſhip is 12 Months. Then I proceed to find out the ſeveral Products, or Stock and Time as followeth.

A had at firſt 364 *l*, for 4 Months, wherefore their Product is	1456
Then he put in 40 *l.* which with the firſt Sum makes 404 *l.* which continued the remainder of the time, *viz.* 8 Months, and their Product is	3232
The Sum of the Products of the Stock and Time of A is	4688

B had 408 *l.* in 7 months, whoſe product is	2856
And then took out 86 *l.* therefore he left in Stock 322 *l.* which continued the reſt of the time, *viz.* five months, whoſe product is	1610
The ſum of the products of the Stock and Time of B is	4466
C put in 148 *l.* for 3 months, whoſe product being multiplied is	444
Then he put in 86 *l.* which added to the firſt, (*viz.* 148 *l.*) makes 234 *l.* which lay in Stock 5 Months, their product is	1170
Then he put in 100 *l.* more, ſo then he had in Stock 334 *l.* which continued the remainder of the time, (*viz.* 4 Months) which multiplied together produce	1336
The Sum of the Product of the Money and Time of C is	2950
B	4466
A	4688
The Total Sum of all the Peoduct is	12104

Then I ſay, as 12104 is to 1436 (the total gain) ſo is 4688 to the ſhare of A in the gaits, &c. go on as in the foregoing Examples, and you will find their ſhares in the Gain to be as followeth, *viz.*

Anſwer,

	l.	s.	d.
The ſhare of A is	556	03	6 $\frac{6192}{12104}$
The ſhare of B is	529	16	9 $\frac{5496}{12104}$
The ſhare of C is	349	19	8 $\frac{416}{12104}$
Sum	1436	00	0

Queſt. 3. Three Graſiers, A, B and C, take a piece of Ground for 46 *l.* 10 *s.* in which A put in 12 Oxen for 8 months, B put in 10 Oxen for 5 months, and C put 18 Oxen for 4 months, now the queſtion is, what ſhall each Man pay of the 46 *l.* 10 *s.* for his ſhare in that charge?

Anſwer,

		l.	s.
A	ſhall pay	18	00
B		15	00
C		13	10
		46	10

3. The proof of this Rule is the ſame with that of *Single Fellowſhip*, laid down in the 5th Rule of the 5th Chapter; and note that,

If a loſs be ſuſtained inſtead of gain amongſt *Partners*, every Man's ſhare to be born in the loſs is to be found after the ſame method as their gain, whether their Stocks be for equal or unequal time.

CHAP. XVII.

Alligation Medial.

1 THE Rule of Alligation is that Rule in plural proportion, by which we reſolve Queſtions, wherein is a compoſition or mixture of divers Simples, as alſo it is uſeful in the compoſition of Medicines both for quantity, quality, and price. And its ſpecies are two, *viz.* Medial and Alternate.

2. Alligation Medial is, when having the ſeveral quantities and prices of ſeveral Simples propounded, we diſcover the mean price or rate of any quantity of the mixture compounded of thoſe Simples, and the proportion is,

As the Sum of the Simples to be mingled is to the total value of all the Simples, ſo is any part or quantity of the Compoſition or mixture to its mean Rate or Price.

Queſt. 1. A Farmer mingleth 20 buſhels of Wheat at 5 *s. per* buſhel, and 36 buſhels of Rye at 3 *s. per* buſhel, with 40 buſhels of Barley at 2 *s. per* buſhel, now I deſire to know what one buſhel of that mixture is worth?

To reſolve this Queſtion add together the given quantities, and alſo their values, which is 96 buſhels, whoſe total value is 14 *l.* 8 *s.* as appeareth by the Work following; for,

buſh.		l.	s.
20	*of Wheat at* 5 s. per *Buſhel, is*	5	0
36	*of Rye at* 3 s. per *Buſhel, is*	5	8
40	*of Barley at* 2 s. per *Buſhel, is*	4	0
The Sum of the given quantities is 96,	*and their value is*	14	8

Then ſay by the Rule of 3 Direct, If 96 buſhels coſt (or is worth) 14 *l.* 8 *s.* what is 1 buſhel worth?

```
bush.   l.    s.   bush.
 96 —— 14 —— 8 —— 1
       20
      ———
 96)  288 (3 s.
       .
      288
      ———          Facit, 3 s. per Bushel.
      (0)
```

Queſt. 2. A Vintner mingleth 15 Gallons of Canary at 8 *s. per* Gallon, with 20 Gallons of Malaga at 7 *s.* 4 *d. per* Gallon, with 10 Gallons of Sherry at 6 *s.* 8 *d. per* Gallon, and 24 Gallons of White-wine at 4 *s. per* Gallon, now I demand what a Gallon of that mixture is worth? Work as in the laſt Queſtion, and you will find the Anſwer to be 6 *s.* 2 *d.* 2 *qrs* $\frac{46}{69}$.

Queſt. 3. A Grocer hath mingled 3 *C.* of Sugar at 56 *s. per C.* with 3 *C.* of Sugar at 3 *l.* 14 *s.* 8 *d. per C.* and with 6 *C.* at 1 *l.* 17 *s.* 04. *d. per C.* I deſire to know the price of a hundred weight of that mixture? *Anſwer,* 2 *l.* 11 *s.* 4 *d.*.

The Proof of Allig. Medial.

3. The proof of this Operation is by the price of any quantity of the mixture to find out the total value of the whole Compoſition, and if it is equal to the total value of the ſeveral ſimples, the Work is right, otherwiſe not. As in the firſt Example, the Anſwer to the Queſtion was, that 3 *s.* is the price of one buſhel; wherefore I ſay by the Rule of Proportion, If 1 buſhel be 3 ſhillings, what is 96 buſhels? *Anſwer,* 14 *l.* 8 *s.* which is the total value of the ſeveral Simples, wherefore the Work is right.

CHAP. XVIII.

Alligation Alternate.

1. ALligation Alternate is when there are given the particular prices of ſeveral ſimples, and thereby we diſcover ſuch quantities of thoſe Simples, as being mingled together ſhall bear a certain Rate propounded.

2. When ſuch a Queſtion is ſtated, place the given prices of the Simples one over the other, and the propounded price of the Compoſition againſt them in ſuch ſort that it may repreſent a Root, and they ſo many branches ſpringing from it, as in the following Example.

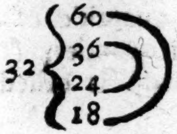
Queſt. 1. A certain Farmer is deſirous to mix 20 buſhels of Wheat at 5 *s.* or 60 *d. per* buſhel, with Rye at 3 *s.* or 36 *d. per* buſhel, and with Barley at 2 *s.* or 24 *d. per* buſhel, and Oats at 1 *s.* 6 *d. per* buſhel, and deſireth to mix ſuch a quantity of Rye, Barley and Oats with the 20 buſhels of Wheat, as that the whole Compoſition may be worth 2 *s.* 8 *d.* or 32 *d. per* buſhel.

The Prices of the Simples being placed according to the laſt Rule, (with the price of the compoſition propounded as a root to them) will ſtand as followeth.

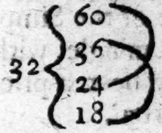
$$32\begin{cases}60 \text{ pence.}\\36\\24\\18\end{cases}$$

3. Having thus placed the given Numbers, you are to link or combine the ſeveral rates of the ſimples the one to the other, by certain Arches, in ſuch a ſort that one that is leſſer than the root (or mean rate) may be linked or coupled to another that is greater than the mean rate, ſo the queſtion laſt propounded will ſtand.

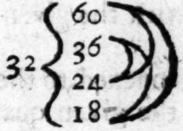
1. *Thus*



2. *Or thus,*

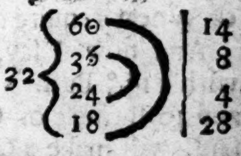


3. *Or thus,*



4. Then take the difference between the root and the ſeveral branches, and place the difference of each againſt the number or branch, with which it is coupled or linked, and having taken all the Differences and placed them as aforeſaid, then thoſe Differences ſo placed will ſhew you the number of each ſimple to be taken to make a compoſition to bear the mean rate propounded.

So the branches of the laſt Queſtion being linked together as in the firſt manner, I ſay the difference between 32 and 60, is 28, which I put againſt 18, becauſe 60 is linked with 18, then the difference between 32 and 36 is 4, which I



put againſt 24, becauſe 36 is linked or coupled with 24, then I ſay, the difference between 32 and 24 is 8, which I place againſt 36 (for the reaſon aforeſaid) then I ſay, the difference between 32 and 18 is 14, which I place againſt 60; and then the Work will ſtand as you ſee in the Margent.

So I conclude that a Compoſition made of 14 Buſhels of Wheat at 60 *d. per* Buſhel, and 8 Buſhels of Rye at 36 *d. per* Buſhel, and 4 Buſhels of Barley at 24 *d. per* Buſhel, and 28 Buſhels of Oats at 18 *d. per* Buſhel, will bear the mean price of 32 *d.* or 2 *s.* 8 *d. per* Buſhel. And here obſerve that in this Compoſition there is but 14 Buſhels of Wheat; but I would mingle 20 Buſhels, and this kind, (or rather caſe) of Alligation Alternate, (*viz.*) when there is given a certain quantity of one of the Simples, and the quantities of the reſt ſought to mingle with this given quantity, (that the whole may bear a price propounded) is called Alternation partial.

And the proportion to find out the ſeveral quantities to be mingled with the given quantity is as followeth, *viz.*

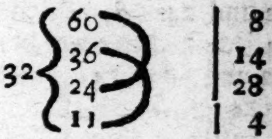
As the difference annexed to the Branch that is the value of an Integer of the given quantity, is to the other particular Differences, ſo is the quantity given to the ſeveral quantities required.

So here, how to find out ſo much Rye, Barley and Oats as muſt be mingled with the 20 Buſhels of Wheat, I ſay by the ſingle Rule of 3 Direct, if 14 Buſhels of Wheat require 8 Buſhels of Rye, what will 20 Buſhels of Wheat require? *Anſwer,* $11\frac{6}{14}$ Buſhels of Rye.

Again, if 14 Buſhels of Wheat require 4 Buſhels of Barley, what will 20 Buſhels of Wheat require? *Anſwer,* $5\frac{10}{14}$ Buſhels of Barley. Again, I ſay, if 14 Buſhels of Wheat require 28 Buſhels of Oats, what will 20 Buſhels of Wheat require? *Anſwer,* 40 Buſhels of Oats.

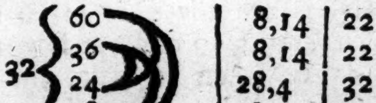
And now I ſay, that 20 Buſhels of Wheat mingled with $11\frac{6}{14}$ Buſhels of Rye, and $5\frac{10}{14}$ Buſhels of Barley, and 40 Buſhels of Oats, each bearing the Rate as aforeſaid, will make a Compoſition or heap of Corn that may yield 32 *d. per* Buſhel.

But if the branches had been coupled according to the ſecond order, or manner, the differences would have been thus placed, *viz.* the difference between 32 and 60 is 28, which I ſet againſt 24, becauſe 60 is linked thereto; and the difference between 32 and 36 is 4, which I ſet againſt 18, and the difference between 32 and 24 is 8, which I ſet againſt 60; then the difference between 32 and 18 is 14, which I ſet againſt his yoke-fellow 36, and then I conclude that if you mix 8 buſhels of Wheat with 14 buſhels of Rye, 28 buſhels of Barley, and 4 buſhels of Oats, each bearing the aforeſaid Prices, the whole mixture may be ſold for 32 *d. per* buſhel, as by the Work in the Margent.



You ſee by this Work, we have found how many buſhels of Rye, Barley and Oats, ought to be mixed with 8 buſhels of Wheat, and to find out how many of each ought to be mixt with 20 buſhels of Wheat, I ſay, as 8 is to 14, ſo is 20 to 35 buſhels of Rye. As 8 is to 28, ſo is 20 to 70 buſhels of Barley. As 8 is to 4, ſo is 20 to 10 buſhels of Oats, whereby I conclude that if to 20 buſhels of Wheat I put 35 buſhels of Rye, 70 buſhels of Barley, and 10 buſhels of Oats, bearing each the foreſaid prices *per* buſhel, that then a buſhel of this mixture will be worth 32 *d.* or 2 *s.* 8 *d.*

And if the Branches had been linked as you ſee in the third place, where each branch bigger than the root is linked to two that are leſſer than the root, than in this caſe you muſt have placed the ſeveral differences between the root and branches, againſt thoſe two with which each is coupled, as firſt the difference between 32 and 60 is 28, which I put againſt 24 and 18, becauſe it is coupled



with them both, then the difference between 32 and 36 is 4, which I ſet likewiſe againſt 24 and 18, becauſe 36 is linked to them both, then the difference between 32 and 24 is 8, which I put againſt 60 and 36, becauſe 24 is linked to them both, then the difference between 32 and 18 is 14, which I put againſt 60 and 36, the yoke fellows of 18.

Laſtly, I draw a line behind the differences, and add the differences which ſtand againſt each branch, and put the ſum behind the ſaid line againſt its proper branch, as you ſee in the Margent.

And now by this work I find that 22 buſhels of the Wheat mingled with 22 buſhels of Rye, and 32 buſhels of Barley, and 32 buſhels of Oats, each bearing the ſaid price will make a mixture bearing the mean rate of 32 *d per* buſhel.

And to find how much of each of the reſt muſt be mingled with 20 buſhels of Wheat, I ſay,

As 22 is to 22, ſo is 20 to 20 buſhels of Rye. As 22 is to 32, ſo is 20 to $29\frac{2}{22}$ buſhels of Barley. As 22 is to 32, ſo is 20 to $29\frac{2}{22}$ buſhels of Oats.

Whereby you ſee the queſtions of Alligation Alternate will admit of more true Anſwers than one; for we have found three ſeveral Anſwers to this firſt Queſtion.

The Proof of Alternation partial.

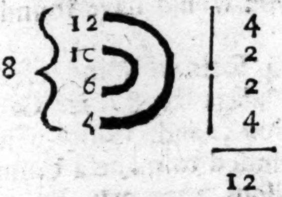
Queſtions of Alternation partial are proved the ſame way with Queſtions in Alligation medial, which you may ſee in the 3*d* Rule of the 17*th*. Chapter.

Queſt. 2. A Grocer hath 4 ſorts of Sugar, *viz.* of 12 *d per l.* of 10 *d. per l.* of 6 *d. per l.* and of 4 *d. per l.* the whole quantity whereof ſhould contain 144 *l.* made of theſe 4 ſorts, I demand how much of each he muſt take?

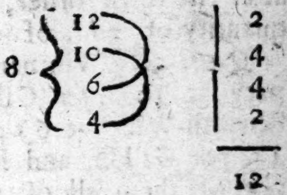
Queſtions of this nature are reſolved by that part of Alligation alternate called by Arithmeticians Alternation total, *viz.* where there is given the ſum, and prices of ſeveral ſimples, to find out how much of each ſimple ought to be taken to make the ſaid ſum or quantity, ſo that it may bear a certain Rate propounded.

To reſolve this Queſtion, I place the ſeveral Prices of the Simples and mean Rate propounded, and link them together, as is directed in the 2d and 3d Rules of this Chapter, and place the differences between the root and branches according to the 4*th* Rule of this Chapter, which then will ſtand one of theſe three ways, *viz.*

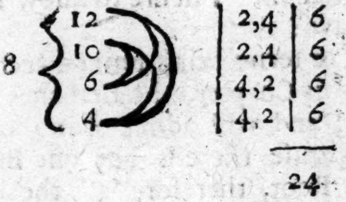
First.



Second.



Third



5. Then add the ſeveral differences together, which I have done, and the Sums of the firſt and ſecond order are 12 *l.* and of the third 24 *l.* as you may ſee above, but it is required that there ſhould be 144 *l.* of the compoſition, therefore to find the quantity of each ſimple, to make the whole compoſition 144 *l.* obſerve this general Rule, *viz.*

As the Sum of the differences is to the ſeveral differences, ſo is the total quantity of the compoſition to the quantity of each ſimple.

So to find how much of each ſort of Sugar I ought to take to make 144 *l.* at 8 *d. per l.* I ſay,

l.
As 12 is to 4, ſo is 144 to 48 *l.* at 12 *d. per l.*
As 12 is to 2, ſo is 144 to 24 *l.* at 10 *d. per l.*
As 12 is to 2, ſo is 144 to 24 *l.* at 6 *d. per l.*
As 12 is to 4, ſo is 144 to 48 *l.* at 4 *d. per l.*

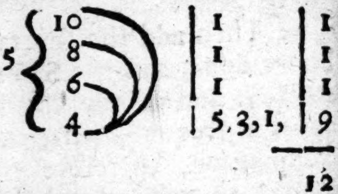
Whereby I find that 48 *l.* at 12 *d. per l.* and 24 *l.* at 10 *d. per l.* and 24 *l.* at 6 *d. per l.* and 48. at 4 *d. per l.* will make a compoſition of Sugar containing 144 *l.* worth 8 *d. per l.*

But as the Branches are linked in the ſecond order, the anſwer will be 24 *l.* at 12 *d. per l.* and 48 *l.* at 10 *d. per l.* and 48 *l.* at 6 *d. per l.* and 24 *l.* at 4 *d. per l.* to make the ſaid quantity, and to bear the ſaid price.

And if you had worked as the Branches are linked after the third order, then you would have found the quantity of 36 *l.* of each.

Queſt. 3. A Vintner hath 4 ſorts of Wine, *viz.* Canary at 10 *s. per* Gallon, Malaga at 8 *s. per* Gallon, Rheniſh-Wine at 6 *s per* Gallon, and White-wine at 4 *s. per* Gallon, and he is minded to make a Compoſition of them all of 60 Gallons that may be worth 5 Shillings *per* Gallon. I deſire to know how much of each he muſt have?

The numbers or terms being ranked according to the ſecond Rule of this Chapter, the Branches will be linked as followeth, and will admit of no other manner of coupling, becauſe there is but one Branch that is leſſer than the Root, therefore all the reſt muſt be linked unto it; and the differences between the Root and the three firſt branches, *viz.* 10, 8, and 6, which are 5, 3, and 1, muſt be ſet againſt 4, becauſe they are all coupled with it, and the difference between the Root (*viz.* 5.) and 4, which is 1, muſt be ſet againſt the 3 other, becauſe it is linked to them all; ſo I find 1 Gallon of Canary, 1 Gallon of Malaga, 1 Gallon of Reniſh-wine, and 9 Gallons of White-wine, Prized as above, being mingled together, will be worth 5 *s per* Gallon, the Sum being 12 Gallons, but there muſt be 60 Gallons; wherefore I ſay,



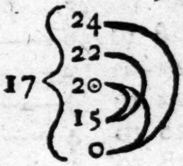
As 12 is to 1, ſo is 60 to 5 Gallons of Canary.
As 12 is to 1, ſo is 60 to 5 Gallons of Malaga.
As 12 is to 1, ſo is 60 to 5 Gallons of Rheniſh.
As 12 is to 9, ſo is 60 to 45 Gallons of White-wine.

So that 5 gallons of Canary, 5 Gallons of Malaga, 5 Gallons of Rheniſh, and 45 Gallons of White-Wine mingled together, will be in all 60 Gallons, worth 5 *s. per* Gallon, which was required.

Queſt. 4. A Goldſmith hath Gold of 4 ſeveral ſorts of fineneſs, *viz.* of 24 Careĉts fine, and of 22 Careĉts fine, of 20 Careĉts fine, and of 15 Careĉts fine. And he would mingle ſo much of each with alloy, that the whole maſs of 28 Ounces of Gold ſo mingled, may bear 17 Careĉts fine. I demand how much of each he muſt take, the ſecond and third Rules of this Chapter being obſerved, (for inſtead of the alloy I put 0, (becauſe it bears no fineneſs, but it makes a Branch in the Operation) the terms may be Alligated, and the differences added any of theſe 4 ways following, *viz.*

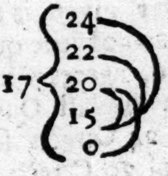
Read Chap. 2. *def.* 2. *of this Book.*

Firſt thus,



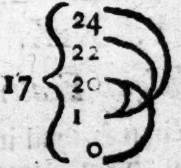
17	24	17	17
	22	2	2
	20	2, 17	19
	15	5, 3	8
	0	7, 3	10
		Sum	56

Secondly thus,



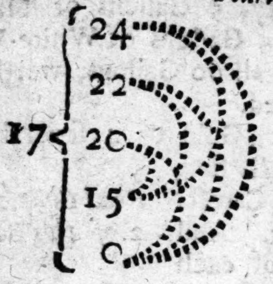
17	24	2	2
	22	17	17
	20	2, 17	19
	15	7, 3	10
	0	5, 3	8
		Sum	56

Thirdly thus,



17	24	2,	2
	22	2,	2
	20	2, 17	19
	1	7, 5, 3,	15
	0	3,	3

Fourthly thus,



2, 17	19
2, 17	19
2, 17	19
7, 5, 3	15
7, 5, 3	15
Sum	87

More ways may be given for the Alligating, or linking of the Terms in this Queſtion, but theſe are ſufficient for the Induſtrious, and it ſhall alſo ſuffice to give an Anſwer to the Queſtiou as the Terms are link'd the firſt way, not doubting but the ingenious Practitioner will be able at his leiſure to find Anſwers to the other 3 ways, *viz.*

	oz.	*p w.*	*car.*
As 56 is to 17, ſo is 28 to	8	10	of 24
As 56 is to 2, ſo is 28 to	10	00	of 22
As 56 is to 19, ſo is 28 to	9	10	of 20
As 56 is to 18, ſo is 28 to	4	00	of 15
As 56 is to 10, ſo is 28 to	5	00	of alloy.

Thus much well practiſed and underſtood, is ſufficient for the underſtanding of Alligation.

The proof of Alternation Total. In Queſtions of Alternation Total, the Anſwer given is true, when the Sum of each of the quantity of Simples found, agrees with the Sum or Quantity propounded, as in the laſt Queſtion, the Anſwer was 8 *oz.* 10 *p w.* of 24 Carects fine, 10 *oz.* of 22 Carects fine, 9 *oz.* 10 *p.w.* of 20 Carects fine, 4 *oz* of 15 Carects fine, and 5. *oz.* of Alloy, which added together make 28 *oz.* the quantity propounded.

CHAP. XIX.

Reduction of Vulgar Fractions.

1. WHat a Vulgar Fraction is, and its parts and ſeveral kinds, hath been already ſhewed in

the 19, 20, 21, 22, 23, 24, and 31 Definitions of the firſt Chapter of this Book, which the Learner is deſired diligently to obſerve before he proceeds.

2. To reduce a Vulgar Fraction (which diſcovereth the principal knowledge of Fractions, and therefore ought greatly to be regarded) we ſhall diſcover plainly under theſe eight ſeveral Heads (or Rules) following, *viz*.

1. To reduce a mixt number into an improper Fraction.
2. To reduce a whole number into an improper Fraction.
3. To reduce an improper Fraction into its equivalent whole (or mixt) number.
4. To reduce a Fraction into its loweſt terms equivalent to the Fractions given.
5. To find the value of a Fraction in the known parts of Coyn, Weight, Meaſure, *&c*.
6. To reduce a compound Fraction to a ſimple one of the ſame value.
7. To reduce divers Fractions having unequal Denominators, to Fractions of the ſame value, having an equal Denominator.
8. To reduce a Fraction of one Denomination to another of the ſame value.

1. *To reduce a mixt Number to an improper Fraction.*

The Rule is, *Vide Chap.* 1. *defin.* 31.

Multiply the Integral part (or whole Number) by the denominator of the Fraction, and to the Product add the Numerator, and that Sum place over the Denominator for a new Numerator; ſo this new Fraction ſhall be equal to the mixt number given. As for Example.

1. Reduce 18$\frac{3}{7}$ into an improper Fraction, multiply the whole number 18 by 7 the denominator, and to the Product add the numerator 3, the Sum is 129, which put over the denominator 7, and it makes $\frac{129}{7}$ for the Anſwer, as followeth.

18$\frac{3}{7}$

$$\begin{array}{r} 18\frac{3}{7} \\ 7 \\ \hline 129 \end{array}$$

facit $\frac{129}{7}$

2. Reduce $183\frac{5}{21}$ to an improper ſraction, *facit* $\frac{3848}{21}$.
3. Reduce $56\frac{13}{22}$ to an improper fraction, *facit* $\frac{1245}{22}$.

II. *To reduce a whole number to an improper Fraction.*

The Rule is,

Multiply the given nnmber by the intended denominator, and place the product for a numerator over it. As for *Example.*

Vide Chap. 1. defin. 23.

1. Let it be required to reduce 15 into a Fraction whoſe denominator ſhall be 12. To effect which I multiply 15 by the intended denominator (12) the product is 180, which I place over 12 as a numerator, and it makes $\frac{180}{12}$ which is equal to 15, as was required; as *per* Margent.

facit $\frac{180}{12}$

$$\begin{array}{r} 15 \\ 12 \\ \hline 30 \\ 15 \\ \hline 180 \end{array}$$

2. Reduce 36 into an improper Fraction whoſe denominator ſhall be 26, *facit* $\frac{936}{29}$.

3. Reduce 135 into an improper Fraction whoſe denominator ſhall be 16, *facit* $\frac{2160}{16}$.

III. *To Reduce an improper Fraction into its equivalent whole or mixt number.*

The Rule is,

Divide the Numerator by the Denominator, and the Quotient is the whole number equal to the Fraction, and if any thing remain, put it for a Numerator over the Diviſor. Example.

1. Reduce $\frac{436}{8}$ into its equivalent mixt Number. Divide the Numerator 436 by the Denominator 8, and the Quotient is 54, and 4 remains, which put for a Numerator over the Diviſor 8, the Anſwer is $45\frac{4}{8}$, as followeth,

```
8) 436 (54 4/8.
    ··
   40
   ——
    36          Facit 54 4/8
    32
    ——
     4
```

2. Reduce $\frac{3476}{15}$ to a mixt Number, *facit* $231\frac{11}{15}$.
3. Reduce $\frac{15576}{136}$ to a mixt Number, *facit* $114\frac{72}{136}$.

IV. *To reduce a Fraction into its loweſt terms equivalent to the Fraction given.*

The Rule is,

1. If the *Numerator* and *Denominator* are even *Numbers*, take half of the one, and half of the other as often as may be, and when either of them falls out to be an odd Number, then divide them by any Number that you can diſcover will Divide both *Numerator* and *Denominator* without any Remainder; and when you have thus proceeded as low as yon can reduce them, then thi new *Fraction* ſo found out, ſhall be the *Fraction* yo deſire, and will be in value equal to the given *Fractio* Example.

1. Let it be required to Reduce $\frac{192}{336}$ into its loweſt Terms. Firſt, I take the half of the *Numerator* 192 and it is 96 then half of the *Denominator*, and it is 168, ſo that now it is brought to $\frac{96}{168}$, and next to $\frac{48}{84}$, and by halfing ſtill to $\frac{24}{42}$, and their half is $\frac{12}{21}$, and now I can no longer half it, becauſe 21 is an odd *Number*, wherefore I try to Divide them by 3, 4, 5, 6, &c. and I find 3 divides them both without any remainder, and brings them to $\frac{4}{7}$, as *per* Margent.

192	96	48	24	12	4
336	168	84	42	21	7

So I conclude $\frac{4}{7}$ thus found to be equal in value to the given *fraction* $\frac{192}{336}$.

2. What is $\frac{1036}{1184}$ in its loweſt terms? *Anſwer* $\frac{7}{8}$

3. What is $\frac{1342}{1586}$ in its loweſt terms? *Anſwer* $\frac{11}{13}$

There is yet another way more excellent than the former to reduce a *fraction* into its loweſt terms, and that is by finding a common Meaſurer, *viz.* the greateſt number that will divide the Numerator and Denominator without any remainder, and by that means reduce a *fraction* to its loweſt terms at the firſt work; and to find out this common meaſurer divide the Denominator by the Numerator, and if any thing remains, divide your Diviſor thereby; and if any thing yet remains, then divide your laſt Diviſor by it: do ſo until you find nothing remains; then this laſt Diviſor ſhall be the greateſt common meaſurer, and reduce them into their loweſt terms at one Work.

Vide Ought. Cla. Math. Cap. 7.

Example.

4. Reduce $\frac{228}{304}$ into its loweſt terms by a common meaſurer. To effect which, I divide the Denominator 304 by the Numerator 228 and there remains 76, then I divide 228 (the firſt Diviſor) by 76 (the remainder) and it quotes 3, and nothing remains; wherefore the laſt Diviſor 76 is the common meaſurer, by which I divide the *Numerator* of the given *Fraction*, *viz.* 228, it quotes 3 for a new *Numerator*, then I Divide the *Denominator* 304 by 76, and it quotes 4 for a new *Denominator*, that now I have found $\frac{3}{4}$ equal to $\frac{228}{304}$.

5. Reduce $\frac{6048}{7392}$ into its loweſt terms by a common meaſurer, *facit* $\frac{9}{11}$.

6. Reduce $\frac{3081}{20382}$ into its loweſt terms by a common meaſurer; *facit* $\frac{13}{86}$.

A Compendium.

Note that if the *Numerator* and *Denominator* of a *Fraction*, end each with a Cypher or Cyphers, then cut off as many Cyphers from the one as from the other, and the remaining Figures will be a Fraction of the ſame value, *viz.* $\frac{3400}{7100}$ will be found to be reduced to $\frac{34}{71}$

by cutting off the 2 Cyphers from the numerator and denominator, with a daſh of the Pen thus, $\frac{34|00}{71|00}$, and $\frac{46\,0}{70\,0}$, will be $\frac{46}{70}$, thus $\frac{46|0}{70|0}$, *&c.*

V. *To find the Value of a Fraction in the known parts of Coyn, Weight, &c.*

The Rule is,

Multiply the numerator by the parts of the next inferiour denomination that are equal to an Unit of the ſame denomination with the Fraction, then divide that Product by the denominator, and the quote gives you its value in the ſame parts you multiplied by, and if any thing remain, multiply it by the parts of the next inferiour denomination, and divide as before, do ſo till you can bring it no lower, and the ſeveral quotients will give you the value of the Fraction as was requir'd, and if any thing at laſt remain place it for a numerator over the former denominator; ſome few Examples will make the Rule plain.

1. What is the value of $\frac{27}{29}$ *l. Sterling?* To anſwer this Queſtion I multiply the numerator 27 by 20 (the ſhillings in a pound) the product is 540, which I divide by 29 (the denominator) and the quotient is 18 *s.* and there remains 18, which I multiply by 12 pence, and the product (216) I divide by the denominator 29, the quotient is 7 *d.* and 13 remains, which I multiply by 4 Farthings, the product is 52, which I ſtill divide by 29, the quotient is 1 Farthing, and there remaineth 23, which I put for a numerator over the denominator 29, ſo I find the Value of $\frac{27}{29}$ *l.* to be 18 *s.* 7 *d.* 1 *qr.* $\frac{23}{29}$, as by the following Operation: and after the ſame manner are the values of the Fractions in the ſeveral Examples following found out.

$\frac{27}{29}$ *l*

27
Multiply 20

qr.
29) 540 (18 *s.* 7 *d.* 1$\frac{23}{29}$.
29

250
232

Remains (18)
Multiply 12

36
18

29) 216 (7 *d.*
203

Remains (13)
Multiply 4

qr.
29) 52 (1$\frac{23}{29}$.
29

Remains (23)

s. *d.* *qr.*
Facit 18 —7—1$\frac{23}{29}$.

2. What is the value of $\frac{11}{15}$ *l. Sterling?* *Facit* 14 *s.* 8 *d.*

3. What is the value of $\frac{28}{137}$ *l. Sterling?* *Facit* 4 *s.* 1 *d.* $\frac{27}{137}$

4. What is $\frac{17}{21}$ C. weight? *Facit*, 3 *qrs.* 1 *l.* 5 *oz.* $\frac{7}{21}$.

5. What is $\frac{36}{131}$ *l. Troy* weight? *Facit*, 3 *oz.* 5 *p.w.* 22$\frac{18}{131}$ *gr.*

6. What is $\frac{41}{50}$ of a Year? *Answer*, 299 *days.* 7 *hou.* 12 *min.*

VI. *To reduce a compound Fraction to a ſimple one of the ſame value.*

What a compound Fraction is, hath been ſhewed in Chap. 1. Definition 24, and to reduce it to a ſimple Fraction of the ſame value.

The Rule is,

Multiply the Numerators continually, and place the laſt product for a new Numerator, then multiply the denominators continually, and place the laſt product for a new Denominator. So this ſingle Fraction ſhall be equal to the compound Fraction given. *Example.*

1. Reduce $\frac{2}{3}$ of $\frac{3}{5}$ of $\frac{5}{8}$ to a ſimple Fraction.

Multiply the Numerators 2, 3, and 5 together, they make 30 for a new Numerator; then I multiply the Denominators 3, 5, and 8 together, and their Product is 120 for a Denominator, ſo the ſimple Fraction is $\frac{30}{120}$, and cutting off the Cyphers, it is $\frac{3}{12}$ equal to $\frac{1}{4}$ by the fourth Rule foregoing.

$$
\begin{array}{r}
5 \\
3 \\
\hline
15 \\
8 \\
\hline
120
\end{array}
\qquad\qquad
\begin{array}{r}
2 \\
3 \\
\hline
6 \\
5 \\
\hline
30
\end{array}
$$

Facit, $\frac{30}{120}$ or $\frac{3}{12}$ or $\frac{1}{4}$.

2. What is $\frac{7}{10}$ of $\frac{5}{9}$ of $\frac{4}{7}$ of $\frac{11}{12}$? *Anſwer*, $\frac{1540}{7560}$ or $\frac{154}{756}$ or $\frac{77}{378}$ in its leaſt terms.

3. What is $\frac{11}{12}$ of $\frac{13}{14}$ of $\frac{21}{29}$? *Anſwer*, $\frac{3003}{4872}$.

By this you may know how to find the value of a Compound Fraction, *viz.* firſt reduce it to a ſimple one, and then find out his value by the 5th Rule foregoing.

Exam-

What is the value of $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{9}{10}$ of a Pound?
Anſwer, 11 *s.* 3 *d.*

VII. *To reduce Fractions of unequal Denominators, to Fractions of the ſame value, having equal Denominators.*

The Rule is,

Multiply all the Denominators together, and the Product ſhall be the Common Denominator. Then multiply each Numerator into all the Denominators except its own, and the laſt Product put for a Numerator over the Denominator found out as before: So this new Fraction is equal to that Fraction, whoſe Numerator you multiplied into the ſaid Denominators. Do ſo by all the Numerators given, and you have your deſire.

Example.

1. Reduce $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$, and $\frac{7}{8}$, to a common Denominator. Multiply the Denominators 4, 5, 6, and 8 together continually, and the product is 960 for the common Denominator; then multiply the Numerator 3 into the Denominators, 5, 6, and 8, and the product is 720, which is a Numerator to 960 (found as before) ſo $\frac{720}{960}$ is equal to the firſt Fraction $\frac{3}{4}$, then I proceed to find a new Numerator to the ſecond Fraction, *viz.* $\frac{4}{5}$, and I multiply 4 (into all the Denominators except its own; *viz.*) into 4, 6, and 8, which produceth $\frac{768}{960}$ equal to $\frac{4}{5}$, then multiply the Numerator 5 into the Denominator 4, 5, and 8, the Produſt is $\frac{800}{960}$ equal to $\frac{5}{6}$. Then multiply the numerator 7 into the Denominators 4, 5, and 6, the product is $\frac{840}{960}$ equal to $\frac{7}{8}$, and the work is done; ſo that for $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$, and $\frac{7}{8}$, I have $\frac{720}{960}$, $\frac{768}{960}$, $\frac{800}{960}$, $\frac{840}{960}$.

2. Reduce $\frac{11}{12}$, $\frac{14}{23}$, and $\frac{19}{21}$ into a common denominator, *faciunt* $\frac{5313}{5796}$, $\frac{3528}{5796}$; and $\frac{5244}{5793}$.

VIII.

VIII. *To reduce a Fraction of one Denomination to another.*

1. This is either Aſcending, or Deſcending. Aſcending when a Fraction of a ſmaller is brought to a greater Denomination, and Deſcending when a Fraction of a greater Denomination is brought lower.

2. When a Fraction is to be brought from a leſſer to a greater Denomination, then make of it a Compound Fraction, by comparing it with the intermediate Denominations between it, and that you would have it reduced to, then (by the *6th* Rule foregoing) reduce your Compound to a ſimple Fraction, and the Work is done. Example,

Queſt. 1. It is required to know what part of a pound *ſterling* $\frac{5}{7}$ of a penny is?

To reſolve this, I conſider that 1 *d.* is $\frac{1}{12}$ of a ſhilling, and a ſhilling is $\frac{1}{20}$ of a pound; wherefore $\frac{5}{7}$ *d.* is $\frac{5}{7}$ of $\frac{1}{12}$ of $\frac{1}{20}$ of a pound, which by the ſaid *6th* Rule I find to be $\frac{5}{1680}$ of a pound *ſterling* of *Engliſh* Money.

Queſt. 2. What part of a pound *Troy* weight is $\frac{4}{5}$ of a penny weight? *Anſwer*, $\frac{4}{5}$ of $\frac{1}{20}$ of $\frac{1}{12}$ *l.* equal to $\frac{4}{1200}$ *l. Troy.*

3. When a Fraction is brought from a greater to a leſſer Denomination, then multiply the Numerator by the parts contained in the ſeveral Denominations betwixt it, and that you would reduce it to; then place the laſt Product over the Denominator of the given Fraction. Example,

Queſt. 3. I would reduce $\frac{3}{5}$ *l.* to the Fraction of a penny, to do which, I multiply the Numerator 3 by 20 and 12, the product is 720, which I put over the Denominator 5, it makes $\frac{720}{5}$ of a penny, equal to $\frac{3}{5}$ *l.*

Queſt. 4. What parts of an Ounce *Troy* is $\frac{5}{16}$ *l.*? *Anſwer*, $\frac{60}{16}$ oz.

CHAP. XX.

Addition of Vulgar Fractions.

1. IF your Fractions to be added have a common Denominator, then add all the Numerators together, and place their Sum for a Numerators to the common Denominator, which new Fraction is the Sum of all the given Fractions; and if it be improper, reduce it to a whole or mixt Number, by the 3*d* Rule of the 19*th* Chapter.

Queſt. 1. What is the Sum of $\frac{7}{24}$, $\frac{9}{24}$, $\frac{16}{24}$, and $\frac{14}{24}$?

The Denominators are equal, *viz.* every one is 24, wherefore add the Numerators together, *viz.* 7, 9, 16 and 14, their Sum is 46, which put over the Denominator 24; it makes $\frac{46}{24}$ the Sum of the given Fractions, which will be reduced to the mixt Numbers $1\frac{22}{24}$, or $1\frac{11}{12}$.

2. But if the Fractions to be added have unequal Denominators, then reduce them to a common Denominator by the 7*th* Rule of the 19*th* Chapter, and then add the Numerators together, and put the Sum over the common Denominator, *&c.* as before in the laſt Example.

Queſt. 2. What is the Sum of $\frac{3}{5}$, $\frac{7}{8}$, $\frac{9}{10}$, and $\frac{11}{12}$?

The Fractions reduced to a common Denominator are, $\frac{2880}{4800}$, $\frac{4400}{4800}$, and $\frac{4800}{4800}$, the Sum of their Numerator is 15800, which put over the common Denominator, makes $\frac{15800}{4800}$ or $\frac{158}{48}$ equal to the mixt number $\frac{14}{48}3$ or $3\frac{7}{24}$ for the Sum required.

Queſt. 5. What is the Sum of $\frac{13}{17}$, $\frac{21}{49}$, and $\frac{36}{47}$? *Anſwer*, $1\frac{37555}{3915}$,

If you are to add mixt Numbers together, then add the Fractional parts as before, and if their Sum be an improper Fraction, reduce it to a mixt Number, and add its Integral part to the Integral parts of the given mixt Numbers, and the Work is done.

Queſt. ,4 What is the Sum of $13\frac{3}{4}$ and $24\frac{5}{8}$?

Firſt add the *Fractions* $\frac{3}{4}$ and $\frac{5}{8}$ the ſum is $1\frac{12}{32}$, then add this Integer 1, to 13 and 24, their ſum is 38, and put after it the *fraction* $\frac{12}{32}$ it is $38\frac{12}{32}$ for the *Anſwer*, or it is $38\frac{3}{8}$.

Queſt. 5. What is the ſum of $48\frac{3}{7}$, $64\frac{5}{8}$ and $130\frac{3}{4}$? *Facit*, $243\frac{180}{224}$, or $243\frac{45}{56}$.

4. If any of the *Fractions* to be added is a Compound *Fraction*, it muſt firſt be reduced to a ſimple *Fraction* by the *6th* Rule of Chapter 19, and then add it to the reſt, according to the 2*d*. Rule of this Chapter. Example.

Queſt. 6. What is the Sum of $\frac{3}{4}$, $\frac{5}{8}$, and $\frac{7}{8}$ of $\frac{3}{4}$ of $\frac{5}{6}$?

Reduce $\frac{7}{8}$ of $\frac{3}{4}$ of $\frac{5}{6}$ into a ſimple *fraction*, and it is $\frac{105}{192}$, which reduced with the other two, and added are $2\frac{6000}{4608}$.

Queſt. 7. What is the ſum of $\frac{11}{12}$ and $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{5}{6}$? *Anſwer*, $1\frac{5}{12}$.

5. If the *fractions* to be added are not of one denomination, they muſt be ſo reduced, and then proceed as before.

Queſt. 8. What is the Sum of $\frac{3}{4}$ *l.* and $\frac{5}{6}$ *s.*?

Of the given Fractions here, one is of a pound, and the other the Fraction of a ſhilling; and before you can add them together, you muſt reduce $\frac{5}{6}$ *s.* to the Fraction of a pound as the other is (by the 8*th* Rule of Chapter 19.) and it makes $\frac{5}{120}$ *l.* then $\frac{3}{4}$ *l.* and $\frac{5}{120}$ *l.* will be found to be $\frac{380}{480}$ *l.* or $\frac{38}{48}$ *l.* by the 7th Rule of Chapter 19. and in its loweſt terms $\frac{19}{24}$ *l.* by the 4th Rule of Chapter 19.

It would have been the ſame, if (by the latter part of the 8th Rule of Chapter 19.) you had reduced $\frac{3}{4}$ *l.* to the Fraction of a ſhilling, which you would have found to have been $\frac{60}{4}$ *s.* which added to $\frac{5}{6}$ *s.* by the ſaid 17th Rule of the laſt Chapter, the ſum is 15 *s.* $\frac{20}{24}$ which is equal to the ſum found as before, *viz.* $\frac{19}{24}$ *l.* for (by the 5th Rule of Chapter 19.) the value of $\frac{19}{24}$ *l.* will be found to be 15 *s.* 10 *d.* and ſo will 15 *s.* $\frac{20}{24}$ be found to be juſt as much.

Queſt. 9. What is the Sum of $\frac{2}{5}$ *l.* $\frac{3}{5}$ *s.* and $\frac{3}{5}$ *d.*? *Anſwer*, $\frac{259500}{600000}$, or $\frac{2595}{6000}$ *l.* or in its loweſt terms $\frac{519}{1200}$ *l.*

CHAP. XXI.

Subtraction of Vulgar Fractions.

1. THE Rules in Addition for reducing the given Fractions to one *denomination*, are here to be obſerved; for before *Subtraction* can be made, the Fractions muſt be reduced to a common *denominator*, then ſubtract one *Numerator* from the other, and place the *remainder* over the common *denominator*, which Fraction ſhall be the exceſs or difference between the given Fractions. Example,

Queſt. 1. What is the difference between $\frac{3}{4}$ and $\frac{5}{7}$? The given *fractions* are reduced to $\frac{21}{28}$ and $\frac{20}{28}$, then *ſubtract* the *numerator* 20 from the *numerator* 21, and there remains 1, which being put over the *denominator* 28, makes $\frac{1}{28}$ for the anſwer or difference between $\frac{3}{4}$ and $\frac{5}{7}$.

Queſt. 2. What is the difference between $\frac{5}{6}$ and $\frac{3}{5}$ of $\frac{5}{8}$?

Reduce the compound *fraction* $\frac{3}{5}$ of $\frac{5}{8}$ to a ſimple *fraction*, then proceed as before, and the Anſwer is $\frac{110}{240}$ equal to $\frac{11}{24}$.

2. When a *fraction* is given to be *ſubtracted* from a whole *number*, ſubtract the numerator from the denominator, and put the remainder for a *numerator* to the given *denominator*, and *ſubtract* an Unit (for that you borrow'd) from the whole number, and the remainder place before the *fraction* found as before, which mixt number is the remainder or difference ſought. Example,

Queſt. 3. Subtract $\frac{7}{10}$ from 48.

Anſwer, 47$\frac{3}{10}$; for if you ſubtract 7 (the *numerator*) from 10 (the *denominator*) there remains 3, which put over 10 is $\frac{3}{10}$ and 1 (I borrowed) from 48 reſts 47, to which join $\frac{3}{10}$, and it makes 47 $\frac{3}{10}$ for the exceſs.

Queſt. 4. Subtract $\frac{13}{21}$ from 57, remains 56 $\frac{8}{21}$.

3. If it is required to ſubtract a *Fraction* from a mixt number, or one mixt number from another, reduce the Fractions to a common Denominator, and if the Fraction to be ſubtracted be leſſer than the other, then ſubtract the leſſer Numerator from the greater, and that is a Numerator for the common Denominator; then ſubtract the leſſer Integral part from the greater, and the remainder with the remaining *Fraction* thereto annexed, is the difference required between the two given mixt Numbers. Example,

Queſt, 5. Subtract $26\frac{3}{7}$ from $54\frac{5}{8}$.

Firſt, Subtract $\frac{3}{7}$, *viz.* $\frac{18}{42}$ from $\frac{5}{6}$, *viz.* $\frac{36}{42}$, the remainder is $\frac{17}{42}$, then 26 from 54 remaineth 28, to which annex $\frac{17}{42}$, it makes $28\frac{17}{42}$ for the Anſwer.

4. But if the *Fraction* to be ſubtracted is greater than the *Fraction* from whence you ſubtract, then having firſt reduced the *Fraction* to a common Denominator, take the Numerator of the greater *Fraction* out of the Denominator, and add the remainder to the Numerator of the leſſer *Fraction*, and their Sum is a new Numerator to the common Denominator, which *Fraction* note, then (for the 1 you borrowed) add 1 to the Integral part to be ſubtracted, and ſubtract it from the greater Number, and to the remainder annex the *Fraction* you noted before, ſo this new mixt Number ſhall be the difference ſought. Example.

Queſt. 6. Subtract $14\frac{3}{4}$ from $29\frac{4}{7}$.

The *Fractions* reduced are, *viz.* equal to $\frac{21}{28}$ and $\frac{4}{7}$ equal to $\frac{16}{28}$, now I ſhould ſubtract $\frac{21}{28}$ from $\frac{16}{28}$, but I cannot, therefore I ſubtract 21 from 28 reſts 7, which added to 16 (the leſſer Numerator) makes 23 for a Numerator to 28; *viz.* $\frac{23}{28}$, then I come to the Integral parts 14 and 29 and ſay, 1 that I borrowed and 14 is 15, which taken from 29 there reſts 14, to which annexing $\frac{23}{28}$ it is $14\frac{23}{28}$ for the remainder or difference between $14\frac{3}{4}$ and $29\frac{4}{7}$.

Queſt. 7. Subtract $96\frac{9}{18}$ from $74\frac{4}{9}$, *facit* $37\frac{49}{90}$.

CHAP. XXII.

Multiplication of Vulgar Fractions.

1. IF the Multiplicand and Multiplier are ſimple (or ſingle) Fractions, then multiply the numerators together for a new numerator, and the denominators for a new denominator, which new Fraction is the Product required.

Queſt. 1. What is the product of $\frac{5}{7}$ by $\frac{11}{9}$? *facit* $\frac{45}{77}$.

For the numerators 5 and 9 being multiplied make 45, and the denominators 7 and 11 being multiplied make 77.

Queſt. 2. What is the product of $\frac{18}{23}$ by $\frac{21}{37}$? *fac.* $\frac{378}{851}$?

2. If the Fractions to be multiplied are mixt numbers, reduce them to improper Fractions by the 1ſt Rule of the 19th Chapter, then proceed as before.

Queſt. 3. What is the product of $48\frac{3}{5}$ by $13\frac{5}{6}$?

The given mixt numbers being reduced to improper Fractions, are $48\frac{3}{5}$ equal to $\frac{243}{5}$, and $13\frac{5}{6}$ equal to $\frac{83}{6}$, now $\frac{243}{5}$ multiplied by $\frac{83}{6}$ according to the firſt Rule of this Chapter, produceth $\frac{20169}{30}$ or $672\frac{9}{30}$.

Queſt. 4. What is the product of $430\frac{6}{10}$ by $18\frac{3}{7}$? *facit*, $\frac{555474}{70}$ or $7935\frac{24}{70}$.

3. If a compound Fraction is to be multiplied by a ſimple Fraction, firſt reduce the compound Fraction into a ſimple Fraction, then multiply the one by the other, as is taught above.

Queſt. 5. What is the product of $\frac{16}{21}$ by $\frac{3}{4}$ of $\frac{5}{7}$ of $\frac{4}{5}$?
The Compound Fraction $\frac{3}{4}$ of $\frac{5}{7}$ of $\frac{4}{5}$ reduced is $\frac{60}{140}$ or $\frac{6}{14}$, which multiplied by $\frac{16}{21}$ produceth $\frac{96}{294}$, which in its loweſt terms is $\frac{16}{49}$ for the Anſwer.

And if the Multiplicand and Multiplier are both compound Fractions, reduce them both to ſimple ones, then multiply theſe new Fractions as before, ſo have you the product.

Queſt. 6. What is the product of $\frac{3}{4}$ of $\frac{2}{3}$ by $\frac{3}{5}$ of $\frac{1}{2}$?
Anſwer, $\frac{18}{120}$, in its loweſt terms $\frac{3}{20}$.

Queſt. 7. What is the product of $\frac{2}{2}$ of $\frac{3}{4}$ by $\frac{2}{5}$ of $\frac{5}{8}$?

Anſwer, $\frac{60}{360}$ or $\frac{6}{36}$ in Its leaſt terms $\frac{1}{6}$.

4. If a Fraction be to be multiplied by a whole number, put under the given whole number an Unit for a denominator, whereby it will be an improper Fraction, then multiply theſe Fractions as before. Example.

Queſt. 8. What is the product of 24 by $\frac{2}{3}$?

Anſwer, $\frac{48}{3}$, for 24 by putting an Unit under it will be $\frac{24}{1}$ and $\frac{24}{1}$ by $\frac{2}{3}$ produceth $\frac{48}{3}$ or 16.

Queſt. 9. What is the product of 36 by $\frac{9}{11}$? *Anſwer*, $\frac{324}{11}$ or $29\frac{5}{11}$.

CHAP. XXIII.

Diviſion of Vulgar Fractions.

1. If the Dividend and the Diviſor are both ſimple Fractions, then multiply the numerator of the dividend into the denominator of the Diviſor, and the product is a new numerator, and multiply the denominator of the Dividend into the Numerator of the Diviſor, and the product is a new denominator, which new Fraction thus found, is the Quotient you deſire. Example.

Queſt. 1. What is the Quotient of $\frac{5}{8}$ divided by $\frac{3}{5}$?

$$\frac{3}{5}\Big)\frac{5}{8}\Big(\frac{25}{24}$$

Anſwer, $\frac{25}{24}$ or $1\frac{1}{24}$ for firſt I multiply (5) the numerator of the dividend into (5) the denominator of the diviſor, and the product (25) is a numerator for the Quotient, then I multiply (8) the denominator of the dividend into (3) the numerator of the diviſor, and the product (24) I put in the quotient for a denominator, ſo I find $\frac{25}{24}$ is the quotient ſought.

Queſt. 2. What is the quotient of $\frac{15}{21}$ divided by $\frac{2}{3}$?

Anſwer, $\frac{30}{42}$ equal to $\frac{5}{7}$ in its loweſt terms.

2. But if you would divide a ſimple Fraction by a compound, or a compound by a ſimple, firſt reduce

ſuch compound to a ſimple *Fraction*, then go on as before.

Queſt. 3. What is the Quotient of $\frac{3}{10}$ divided by $\frac{3}{4}$ of $\frac{2}{3}$? *Anſwer*, $\frac{36}{60}$ or $\frac{3}{5}$, firſt reduce $\frac{3}{4}$ of $\frac{2}{3}$ into a *Simple Fraction*, and it is $\frac{6}{12}$ by which $\frac{3}{10}$ being divided, the Quotient is $\frac{36}{60}$, equal in its leaſt terms to $\frac{3}{5}$. And if the Dividend and Diviſor be both compound *Fractions*, reduce them both to ſimple *Fractions*, then divide the one by the other, as in Rule 1. before-going.

Queſt. 4. What is the Quote of $\frac{2}{3}$ of $\frac{3}{4}$ divided by $\frac{2}{5}$ of $\frac{5}{6}$?

Anſwer, $\frac{180}{120}$ or $\frac{18}{12}$ or $1\frac{6}{12}$ or $1\frac{1}{2}$ in its loweſt terms.

3. If the Dividend, or Diviſor, or both are mixt Numbers, reduce them to improper *Fractions*, and perform *Diviſion* as you were taught before. Example.

Queſt. What is the Quote of $12\frac{3}{4}$ divided by $21\frac{4}{5}$?

Anſwer, $\frac{255}{436}$, for $12\frac{3}{4}$ is equal to $\frac{51}{4}$, and $21\frac{4}{5}$ is equal to $\frac{109}{5}$, and the Quote of $\frac{51}{4}$ divided by $\frac{109}{5}$ is as before $\frac{255}{436}$.

4. If you divide a Fraction by a whole Number, or a whole Number by a Fraction, make the whole Number an improper Fraction, by putting an Unit for a Denominator to it, as was taught in Rule 4. of Chap. 22. and then perform *Diviſion* as before was taught. Example.

Queſt. 6. What is the Quote of 8 divided by $\frac{3}{5}$?

Anſw. $\frac{40}{3}$ which is equal to $13\frac{1}{3}$, being reduced as is before directed. See the Work in the Margent.

$$\frac{3}{5}\Big)\frac{8}{1}\Big(\frac{40}{3} \text{ or } 13\tfrac{1}{3}.$$

Queſt. 7. What is the quotient of $\frac{3}{5}$ divided by 8? *Anſwer*, $\frac{3}{40}$ as per Margent.

$$\frac{8}{1}\Big)\frac{3}{5}\Big(\frac{3}{40}$$

CHAP.

CHAP. XXIV.

The Rule of Three Direct in Vulgar Fractions

1. AS in the *Rule of Three* in whole *Numbers*, ſo likewiſe in *fractions*, you muſt ſee that the *fractions* of the firſt and third places be of the ſame denomination.

2. See that if any of the given *fractions* be compound, that they be reduced to ſimple of the ſame Value.

3. If there are given mixt numbers, reduce them to improper Fractions by the firſt Rule of Chap. 19.

4. If any of the three terms is a whole number, make it an improper *fraction* by conſtituting an Unit for its denominator.

Having reduced your Fraction as is directed in the four laſt Rules, then proceed to a Reſolution which is performed the ſame way as in whole Numbers, reſpect being had to the Rules delivered for the working of *fractions*, *viz.* multiply the 2d and 3d *fraction* together, according to the 1ſt Rule of Chap. 22. and divide the product by the firſt *fraction*, according to the 1ſt. Rule of Chap. 23. and the Quotient is the Anſwer.

Or (which is better)

5. Multiply the numerator of the firſt *fraction* into the denominators of the ſecond and third, and the product is a new denominator, then multiply the denominator of the firſt *fraction* into the numerators of the ſecond and third, and the product is a new numerator; which new *fraction* is the 4th proportional or anſwer, which (if it is an improper *fraction*) muſt be reduced to a whole or mixt number by the third Rule of Chap. 19. Examples,

Queſt. 1. If $\frac{3}{4}$ yards of Cloth coſt $\frac{5}{8}$ *l.* what will $1\frac{1}{6}$ yards coſt?

Having placed the given *fractions* according to the 6 Rule of Chap. 10. I proceed to the reſolution, and firſt I multiply the numerator of the firſt *fraction* (3) into 8 and 10, the denominators of the ſecond and third fractions and the product is 240 for a denominator, then I multiply 4 the denominator of the firſt fraction into 5 and 9 the Numerators of the ſecond and third fractions, the product is 180 for a Numerator, which Numerator 180 and denominator 240 make $\frac{180}{240}$ *l.* for the Anſwer, equal to $\frac{3}{4}$ *l.* or 15 *s.*

$$\begin{array}{cccc} \textit{yds.} & \textit{l.} & \textit{yds.} & \textit{l.} \\ \frac{3}{4} & \frac{5}{8} & \frac{9}{10} & \frac{180}{240} \\ & \textit{l.} & & \textit{l.} \\ \textit{facit} & \frac{180}{240} & \text{equal to} & \frac{3}{4} \end{array}$$

Queſt. 2. If $\frac{2}{3}$ *l.* buy $\frac{5}{6}$ *yds.* of Cloth, what will $\frac{11}{12}$ *yds.* coſt at that rate?

Anſwer, $\frac{132}{180}$ *l.* equal to $\frac{11}{15}$ *l.* or 14 *s.* 8 *d.*

Queſt. 3. If $\frac{7}{8}$ *l.* coſt $\frac{3}{4}$ *s.* what will $\frac{8}{9}$ *s.* buy?

Anſwer, $\frac{224}{216}$ *l.* equal to $1\frac{1}{27}$ *l.*

Queſt. 4. If $\frac{3}{5}$ of an Ell of Holland coſt $\frac{1}{3}$ of a pound, how much will $12\frac{2}{3}$ Ells coſt at that rate?

Anſwer, $\frac{190}{27}$ equal to $7\frac{1}{27}$ *l.*

In reſolving the laſt queſtion and the two next, obſerve the third Rule of this Chapter foregoing.

Queſt. 5. If $\frac{9}{10}$ of a *C.* coſt 284 *s.* what will $7\frac{1}{2}$ *C.* coſt at that rate?

Anſwer, $2366\frac{2}{3}$ *s.* or 118 *l.* 6 *s.* 8 *d.*

Queſt. 6. If $3\frac{1}{4}$ *yds.* of Velvet coſt $3\frac{5}{8}$ *l.* how much will $10\frac{1}{2}$ *yds.* coſt at that rate?

Anſwer, $11\frac{37}{52}$ *l.*

Queſt. 7. If 3 *yds.* of Broad Cloth coſt $2\frac{4}{5}$ *l.* what will $14\frac{3}{7}$ *yds* coſt?

Anſwer, 13 *l.* 9 *s.* 4 *d.*

In working the laſt queſtion and the 4 next, obſerve the 4*th.* Rule of this Chapter foregoing.

Queſt. 8. If 14 *l.* of Pepper coſt 14 *s.* $6\frac{3}{5}$ *d.* I demand the price of $73\frac{3}{4}$ *l.*

Anſwer, 3 *l.* 16 *s.* $7\frac{43}{56}$ *d.*

Queſt. 9. If 1 *l.* of Cochenele coſt 1 *l.* 5. what will $36\frac{7}{10}$ *l.* coſt?

Anſwer, 45 *l.* 17 *s.* 6 *d.*

Queſt. 10. If one yard of Broad-cloth coſt $15\frac{5}{8}$ *s.* what will 4 pieces, each containing $27\frac{3}{7}$ yards at that rate?

Anſwer, 85 *l.* 14 *s.* $3\frac{3}{7}$ *d.*

Queſt. 11. A Mercer bought $3\frac{1}{2}$ pieces of Silk, each piece qt. $24\frac{2}{3}$ Ells at 6 *s.* $0\frac{3}{4}$ *d.* *per* Ell, I demand the value of $3\frac{1}{2}$ pieces at that rate?

Anſwer, 26 *l.* 3 *s.* $4\frac{3}{4}$ *d.*

In reſolving the 4 next Queſtions obſerve the 8th Rule of Chapter 19.

Queſt. 12. If $\frac{2}{5}$ of an ounce of Silver coſt 2 *s.* I demand the price of $11\frac{2}{3}$ *l.* at that rate?

Anſwer, 35 *l.*

Queſt. 13. If $5\frac{5}{7}$ *l.* of Gold is worth 205 *l.* 14 *s.* $3\frac{3}{7}$ *d.* what is 1 grain worth at that rate?

Anſwer, $1\frac{1}{2}$ *d.*

Queſt. 14. If $\frac{3}{4}$ yds of Silk is worth $\frac{3}{4}$ of $\frac{5}{6}$ *l.* what is the price of $15\frac{2}{3}$ Ells *Flemiſh*?

Anſwer, 9 *l.* 12 *s.* 6 *d.*

Queſt. 15. If $\frac{2}{3}$ of $\frac{3}{4}$ of a pound of Cloves coſt 6 *s.* $2\frac{2}{7}$ *d.* what coſt the *C.* weight at that rate?

Anſwer, 69 *l.* 6 *s.* 8 *d.*

Note, That when the Anſwers to the Queſtions in this and the next Chapter are given in Fractions, they are given in their loweſt terms.

CHAP. XXV.

The Rule of Three Inverſe in Fractions.

1. IT hath been already taught (in the third Rule of the 11th Chapter) how to diſcover when the 4th proportional number (to the three given numbers) is to be found out by a Rule of 3 Direct, and when by a Rule of 3 Inverſe, to whibh Rule the Learner is now referred.

2. When (in Fractions you find a queſtion to be ſolved by the Rule of 3 Inverſe, *viz.* when the third Term is the Diviſor, (then having reduced the terms

exactly according to the Rules in Chap. 24.) multiply the Numerators of the 3 Fractions into the Denominators of the ſecond and firſt Fractions, and the product is a new Denominator, then multiply the Denominator of the third Fraction into the Numerators of the ſecond and firſt Fractions, and the Product is a new Numerator, which new Fraction thus found is the Anſwer to the Queſtion.

Queſt. 1. If $\frac{3}{4}$ of a yard of Cloth that is 2 *yds* wide will make a Garment, how much of any other Drapery that is $\frac{3}{5}$ of a yard wide will make the ſame Garment?

Anſwer, 2$\frac{1}{2}$ yards.

Queſt. 2. I Lent my Friend 46 *l.* for $\frac{4}{5}$ of a Year, how much ought he to lend me for $\frac{7}{12}$ of a Year?

Anſwer, 63$\frac{3}{35}$ *l.*

Queſt. 3. If $\frac{2}{3}$ of a yard of Cloth that is 2$\frac{1}{2}$ yards wide will make any Garment, what breadth is that Cloth, when 1$\frac{3}{4}$ yards will make the ſame Garment?

Anſwer, $\frac{39}{63}$ of a yard wide.

Queſt. 4. How many Inches in length of a Board that is 9 Inches broad will make a Foot ſquare?

Anſwer, 16 Inches in length.

Queſt. 5. If when the Buſhel of Wheat coſt 4$\frac{3}{4}$ *s*, the penny Loaf weigheth 10$\frac{2}{3}$ Ounces, what will it weigh when the Buſhel coſt 8$\frac{9}{10}$ *s.*?

Anſwer, 5$\frac{184}{264}$ Ounces.

Queſt. 6. If 12 Men can Mow 24$\frac{1}{2}$ Acres in 10$\frac{2}{3}$ Days, in how many Days will 6 Men do the ſame?

Anſwer, In 21$\frac{1}{3}$ Days.

CHAP. XXVI.

Rules of Practice.

IN the Single Rule of Three, when the firſt of the 3 Numbers in the Queſtion (after they are diſpoſed according to the 6th Rule of Chap. 10.) hapneth to be an Unit (or 1) that Queſtion many times may be reſolved far more ſpeedily than by the Rule of 3, which kind of Operation is commmonly called Practice, and indeed it is of excellent uſe amongſt Merchants, Tradeſmen, and others, by reaſon of its ſpeedineſs in finding a Reſolution to ſuch kind of Queſtions.

2. The chiefeſt Queſtion reſolvable by theſe brief Rules may be comprehended under the ſeveral general Heads or Caſes following, *viz.*

When the given price of the Integer conſiſts,
1. *Of farthings under* 4.
2. *Of pence under* 12.
3. *Of pence and farthings.*
4. *Of ſhillings under* 20.
5. *Of ſhillings, pence and farthings.*
6. *Of pounds.*
7. *Of pounds, ſhillings, penee and farthings.*

It would be very convenient for the Practical Arithmetician to have by heart the ſeveral products of the Nine Digits multiplied by 12, for his ſpeedy reducing pence into ſhillings, or ſhillings into pence, which he may gain by the following Table.

12 Times	1	is	12
	2		24
	3		36
	4		48
	5		60
	6		72
	7		84
	8		96
	9		108

3. Shillings are practically reduced into Pounds thus *viz.* cut off the figure ſtanding in the place of Units with a daſh of the Pen, and note it for Shillings, then draw a Line under the given Number, and take

half of the remaining figures (after the firſt is cut off) and ſet them under the line, and they are ſo many pounds, but if the laſt figure is odd, then take the leſſer half, and add 10 to the figure ſo cut off (as before) for ſhillings, as if I were to reduce 43658 ſhillings into pounds, firſt I cut off the laſt figure (8) for ſhillings, then I take half of the remaining figures (4365) thus, half of 4 is 2, which I put under the line, then $\frac{1}{2}$ of 3 is 1, and becauſe 3 is an odd number, I make the next figure *6* to be 1*6*, and I go on, ſaying, $\frac{1}{2}$ of 16 is 8, and then $\frac{1}{2}$ of 5 is 2, which is the laſt figure; wherefore becauſe 5 is an odd number, I add 10 to the 8 I cut off, and it makes 18 *s.* ſo that I find it to be 2182 *l.* 18 *s.* as *per* Margent.

l.	s.
4365	8
2182	18

4. It is likewiſe convenient that the Learner be acquainted with the practical Tables following, the firſt containing the Aliquot (or even) parts of a ſhilling, the ſecond containing the Aliquot parts of a pound.

	d.		s.
The even parts of a ſhilling.	6	is	$\frac{1}{2}$
	4		$\frac{1}{3}$
	3		$\frac{1}{4}$
	2		$\frac{1}{6}$
	$1\frac{1}{2}$		$\frac{1}{8}$
	1		$\frac{1}{12}$

	s.	d.		l.
The even parts of a pound.	10	00	is	$\frac{1}{2}$
	6	08		$\frac{1}{3}$
	5	00		$\frac{1}{4}$
	4	00		$\frac{1}{5}$
	3	04		$\frac{1}{6}$
	2	06		$\frac{1}{8}$
	2	00		$\frac{1}{10}$
	1	08		$\frac{1}{12}$
	1	00		$\frac{1}{20}$

Caſe

Caſe 1.

5. When the price of the Integer is a Farthing, then take the 6th part of the given number, which will be ſo many three-half-pences, and if any thing remains it is Farthings, by the 7th Rule of Chapter 9. then conſider that three-half-pence is $\frac{1}{8}$ of a ſhilling, wherefore take the eighth part of them for ſhillings, and if any thing remain they are ſo many 3 half-pence, which reduce into pounds by the third Rule foregoing. Example, What comes 67486 *l.* to, at a Farthing *per l.* Firſt, I take $\frac{1}{6}$ of 67486 and it is 11247 three-half-pence and 4 Farthings, or one Penny; then $\frac{1}{8}$ of 11247 is 1405 *s.* and 7 remains, which is 7 three-half-pence, or 10$\frac{1}{2}$ *d.* which with the 4 Farthings before make 11$\frac{1}{2}$ *d.* and 1405 ſhillings, which by the 3d Rule is 70 *l.* 5 *s.* In all 70 *l.* 5 *s.* 11 *d.* $\frac{1}{2}$ for the *Anſwer*. See the work following.

l. *d.*
$\frac{1}{6}$ | 67486 at $\frac{1}{4}$ per *l.*
d.
$\frac{1}{8}$ | 11247—1
$\frac{1}{2}$ | 140|5—10$\frac{1}{2}$
l. *s.* *d.*
70—5—11$\frac{1}{2}$ *facit.*

Other Examples follow.

$\frac{1}{6}$ | 8576 l. at 1 *qrs.*
$\frac{1}{8}$ | 1429——2 *qrs.*
$\frac{1}{20}$ | 17|8——8 *d.*
l. s. d.
8—18—8 *facit.*

$\frac{1}{6}$ | 6386 l. *at* 1 *qr.*
$\frac{1}{8}$ | 1063——2 *qrs.*
$\frac{1}{20}$ | 13|2——11 *d.*
l. s. d.
6—12—11 *fait.*

6. When the price of the Integer is 2 Farthings, then take the third part of the given Number for ſo many three-half-pences, and the remainder (if any) is half-pence, then take the eighth part of that for Shillings, as before, &c.

Examples.

$\frac{1}{3}$	7368 *l. at* 2 *qrs.*
$\frac{1}{8}$	2456
$\frac{1}{2\vert0}$	30|7
	l. s.
	15——7 *facit*

$\frac{1}{3}$	8347 *l. at* 2 *qrs.*
$\frac{1}{8}$	2782——2 *qrs.*
$\frac{1}{2\vert0}$	34|7——9 *d.* $\frac{1}{2}$
	l. s. d.
	17—7—9½ *facit*

7. When the price of the Integer is 3 Farthings, then take half the given Number for three-half-pence, (and if any thing remain it is 3 Farthings) then take the eighth of that for Shillings, as before, &c.

Examples.

$\frac{1}{2}$	4736 *l. at* 3 *qrs*
$\frac{1}{8}$	2368
$\frac{1}{2\vert0}$	29|6
	l. s.
	14—16 *facit*

$\frac{1}{2}$	5425 l. *at* 3 *qrs.*
$\frac{1}{8}$	2712——8 *qrs*
$\frac{1}{2\vert0}$	33|9
	l. s. d. qrs.
	16—7—0--3 *fa.*

Caſe 2.

8. When the given price of the Integer, is a part, or parts of a Shilling, (*viz.* Pence) divide the given number of Integers (whoſe value is ſought) by the Denominator of the Fraction repreſenting the even part, and the Quote is Shillings (always minding the 7th Rule of the 9th Chap.) and thoſe Shillings may be reduced into Pounds by the 3d Rule of this Chapter. Example, Let it be required to find the value of 438 *l.*

at 3 *d. per l.* I conſider 3 *d.* is $\frac{1}{4}$ of a Shilling, and 438 *l.* will coſt ſo many 3 Pences, wherefore I divide 438 by 4 the Denominator of $\frac{1}{4}$, and the Quote is 109 Shillings, and 2 remains, which is 2 three-Pences or 6 *d.* the whole value is 5 *l.* 9 *s.* 6 *d.* as by the following Work appeareth.

$\frac{1}{4}$ | 438 *l.* at 3 *d.*
$\frac{1}{20}$ | 10|9——6
l. s. d.
facit 5—9—6

More Examples follow.

l. d.
$\frac{1}{2}$ | 3574 *at* 6 *per l.*
$\frac{1}{20}$ | 178|7
facit 89 *l.* 7 *s.*

l. d.
$\frac{1}{6}$ | 5316 *at* 2 *per l.*
$\frac{1}{20}$ | 88|6
facit 44 *l.* 6 *s.*

l. d.
$\frac{1}{3}$ | 438 *at* 4 *per l.*
$\frac{1}{20}$ | 14|6
facit 7 *l.* 6 *s.*

l. d.
$\frac{1}{8}$ | 6389 *at* 1$\frac{1}{2}$ *per l.*
$\frac{1}{20}$ | 79|8——7*d.* $\frac{1}{2}$
facit 39 *l.* 18 *s.* 7 *d.* $\frac{1}{2}$

l. d.
$\frac{1}{4}$ | 879 *at* 3 *per l.*
$\frac{1}{20}$ | 21|9 — 9 *d.*
facit 10 *l.* 19 *s.* 9 *d.*

l. d.
$\frac{1}{12}$ | 818 *at* 1 *per l.*
$\frac{1}{20}$ | 6|8——2 *d.*
facit 3 *l.* 8 *s.* 2 *d.*

9. if the price of the Integer be Pence under 12 and yet not an even part, then it may be divided int even parts, and ſo the parts of the given Number ta-

ken accordingly, and added together, as if it were 5 *d.* which is 3 *d.* and 2 *d.* *viz.* $\frac{1}{4}$ and $\frac{1}{6}$ of a ſhilling, firſt take $\frac{1}{4}$ of the given number, and then $\frac{1}{6}$ thereof, and add them together, and their Sum is the Anſwer in ſhillings, ſtill obſerving Rule 7. of Chap. 9. for the remainders (if any be) then bring the ſhillings into pounds by the 3d Rule foregoing. Likewiſe 7 *d.* is $\frac{1}{3}$ and $\frac{1}{4}$, ſo 9 *d.* is $\frac{1}{2}$ and $\frac{1}{4}$, and 10 *d.* is $\frac{1}{2}$ and $\frac{1}{3}$, and 11 *d.* is $\frac{1}{3}$ and $\frac{1}{3}$ and $\frac{1}{4}$ of a ſhilling, or elſe many times your work may be ſhortned thus, *viz.* when the ſaid given price is to be divided into even parts of a ſhilling or of a pound, after you have taken the firſt even part, the other may be an even part of that part, as in the next Example, where is given 439 *l.* at 5 *d. per l.* now I may divide it thus, *viz.* into 4 *d.* and 1 *d.* and 4 *d.* being $\frac{1}{3}$ of a ſhilling, and 1 *d.* being $\frac{1}{4}$ of 4 *d.* I firſt take $\frac{1}{3}$ of 439 *l.* and it gives 146 *s.* 4 *d.* and for the 1 *d.* I take $\frac{1}{3}$ of 146 *s.* 4 *d.* which is 36 *s.* 7 *d.* which in all comes to 9 *l.* 2 *s.* 11 *d.* Examples follow.

l. d.
439 *at* 5 *per l.*
$\frac{1}{3}$ 146—4
$\frac{1}{4}$ 36—7
18|2—11
9 *l.* 2 *s.* 11 *d. facit*

yds d.
417 *at* 9 *per yd.*
$\frac{1}{2}$ 208—6
$\frac{1}{2}$ 104—3
31|2—9
15 *l.* 12 *s.* 9 *d. facit*

ells d.
587 *at* 7 *per ell.*
$\frac{1}{3}$ 195—8
$\frac{1}{4}$ 146—9
34|2—5
17 *l.* 2 *s.* 5 *d. facit*

ells d.
286 *at* 10
$\frac{1}{2}$ 193
$\frac{1}{3}$ 128—8
32|1—8
16 *l.* 1 *s.* 8 *d. facit*

826

	yds.	d.	
	836	*at* 8	*per yd.*
$\frac{1}{3}$	278	8	
$\frac{1}{3}$	278	8	
	55|7	4	
	27 *l.* 17 *s.* 4 *d.* *facit*		

	l.	d.
	534	*at* 11
$\frac{1}{3}$	178	
$\frac{1}{3}$	178	
$\frac{1}{4}$	133	6
	48|0	6
	24 *l.* 9 *s.* 6 *d.* *facit*	

Caſe 3.

10. When the price of the Integer is pence and farthings, if it make an even part of a ſhilling, work as before, but if they are uneven, as penny farthing, penny three-farthings, 2 *d.* 1 *qr.* or 2 *d.* 3 *qrs.* or 3 *d.* 3 *qrs.* or the like, then firſt work for ſome even part, and then conſider what part the reſt is of that even part, and divide that quotient thereby, then add them together, and reduce them to pounds as before. Example, 3470 *l.* at 1 *d.* 1 *qr.* *per l.* firſt I work for the penny by dividing 3470 by 12, for 1 *d.* is $\frac{1}{12}$ of a ſhilling, and the quote is 289 *s.* 2 *d.* then I conceive that one farthing is the $\frac{1}{4}$ of a penny, and the value of 1 farthing, will be $\frac{1}{4}$ of the value at one penny, and therefore I take $\frac{1}{4}$ of 289 *s.* 2 *d.* which is 72 *s.* 3 *d.* 2 *qrs.* and add them together, and they are 18 *l.* 1 *s.* 5 *d.* 2 *qrs.* as by the Margent. Other Examples of the ſame nature follow.

	l.	*qrs.*	
$\frac{1}{12}$	3470	*at* 5	
$\frac{1}{4}$	289	2	
	72	3	2
$\frac{1}{20}$	36|1	5	2
	l.	*s.*	*d.*
	18	1	5½

	l. d.
$\frac{1}{12}$	4360 *at* 1 $\frac{1}{4}$
$\frac{1}{4}$	363——4
	90——10
	45|4—2
	l. *s.* *d.*
	22—14—2 *facit*

$\frac{1}{6}$	485 *l.* *at* 2 $\frac{1}{4}$ *d.*
$\frac{1}{8}$	80——10 *d.*
	10—— 1 $\frac{1}{4}$
	9|0——11 $\frac{1}{4}$
	4 *l.* 10 *s.* 11 $\frac{1}{4}$ *d.*

$\frac{1}{6}$	654 *l.* at 2 $\frac{1}{2}$ *d.*
$\frac{1}{4}$	109
	27—— 3 *d.*
	13|6——3
	6 *l.* 16 *s.* 3 *d.*

	yds d.
$\frac{1}{8}$	573 *at* 1 $\frac{3}{4}$
$\frac{1}{6}$	71——7 $\frac{1}{2}$ *d.*
	11——11 $\frac{1}{4}$
	8|3——6 $\frac{3}{4}$
	l. *s.* *d.*
	facit 4—3—6 $\frac{3}{4}$

$\frac{1}{2}$	420 *yds* at 7 $\frac{1}{2}$
$\frac{1}{4}$	263
	65
$\frac{1}{20}$	32|5
	16 *l.* 5 *s.* *facit*

$\frac{1}{2}$	137 *yds* at 10 $\frac{1}{2}$ *d.*
$\frac{1}{2}$	68——6 *d.*
$\frac{1}{2}$	34——3
	17——1 $\frac{1}{2}$
$\frac{1}{20}$	11|9——10 $\frac{1}{2}$ *d.*
	5 *l.* 19 *s.* 10$\frac{1}{2}$ *facit*

Caſe 4.

11. When the price of the Integer is 2 *s.* then cut off the figure in the place of Units of the given number, and double it for ſhillings, and the figures on the other hand are pounds. Example, 436 *yds* at 2 *s. per yd*, cut off the laſt figure 6 and double it, it makes 12 ſhillings, and the other two figures, *viz.* 43 are ſo many pounds, ſo that their value is 43 *l.* 12 *s.* as *per* Margent.

43 | 6	
43 *l.*	12 *s.*

12. Hence it is evident that when the given price of an Integer is an even number of ſhillings, then if you take half of that even number of ſhillings, and multiply the given number of Integers thereby, doubling the firſt figure of the product, and ſetting it apart for ſhillings, the reſt of the product will be pounds, which pounds and ſhillings is the value ſought. Example, What coſt 536 *yds.* at 8 *s. per yd?* To reſolve which I take $\frac{1}{2}$ of 8 *s.* (the price of a *yd.*) which is 4, and multiply 536 thereby, ſaying, 4 times 6 is 24, then I double the firſt figure 4, makes 8 for ſhillings, and carry 2 to the next product, *&c.* I find the reſt of the product to be 214, which I note for pounds, ſo the value of 536 *yds.* at 8 *s. per yd.* is 214 *l.* 8 *s.* as *per* Margent. More Examples follow.

536 *yds.* at 8 *s.*
4

---

214 *l.* 8 *s.*

56 *yds.* at 6 s *per yd.*	420 *yds.* at 12s. *per yd.*
16l. 16s. *facit.*	252l. *facit.*
123 *yds.* at 4s. *per yd.*	326 *yds.* at 14s. *per yd.*
24l. 12s. *facit.*	228l. 4s. *facit.*
48 *ells* at 8s. *per ell.*	48 *yds.* at 16s. *per yd.*
19l. 4s. *facit.*	98l. 8s. *facit.*
84 *yds.* at 10s. *per yd.*	52 *yds.* at 18 s. *per yd.*
42l. *facit.*	46l. 16 s. *facit.*

13. If the given price of the Integer is an odd number of ſhillings, then work firſt for the even number of ſhillings by the laſt Rule, and for the odd ſhilling take $\frac{1}{20}$ of the given Number of Integers according to the 3d Rule of this Chapter, and add them together, and you have your deſire. Examples follow.

yds. s.
422 at 3 per yard.

l. s.
42——4
21——2

63——6 facit.

ells. s.
431 at 13

l. s.
258——12
21——11

280——03 facit.

ells. s.
516 at 7 per ell.

l. s.
154——16
25——16

180——12 facit.

ells. s.
324 at 17 per ell.

l. s.
259——04
16——04

275——08 facit.

14. Except when the given price of the Integer is 5 *s.* for then it is ſooner anſwered by taking ¼ of the given number whoſe value is ſought, as in the following Example.

¼ | yds. s.
436 at 5

109 *l.* facit.

¼ | ells s.
206 at 5 per ell

51 *l.* 10 *s.* facit.

Caſe 5.

15. When the given price of an Integer is ſhillings and pence, or ſhillings, pence and farthings; then if the ſhillings and pence be an even part of a pound, divide the given number of Integers, whoſe value you ſeek by the denominator of that Fraction repreſenting that even part. As for Example, What is the price of 384 *yards* at 6 *s.* 8 *d. per yard*? Here I conſider that 6 *s.* 8 *d.* is ⅓ of a pound,

wherefore I divide 384 by 3, and the quote is the *Anſwer*, *viz.* 128 *l.* ſo that 384 *yds*, at 6 *s.* 8 *d.* *per yd.* amounts to 128 *l.* as *per* Margent, ſtill obſerving the 7*th* Rule of the 9th Chapter.

$\frac{1}{3}$ | 384
128 *l.* *facit.*

More Examples follow.

$\frac{1}{3}$ | 438 *ells at* 6 *s.* 8. *d.*
146 *l.* *facit.*

$\frac{1}{8}$ | 443 *yds. at* 2 *s.* 6 *d.*
55 *l.* 7*s.* 6 *d.* *facit.*

$\frac{1}{6}$ | 525 *at* 3 *s.* 4 *d.*
87 *l.* 10 *s.* *facit.*

$\frac{1}{12}$ | 726 *yds at* 1 *s.* 8 *d.*
60 *l.* 10 *s.* *facit.*

16. When the gvien value of the Integer is ſhillings and pence, and not an even part of a pound, yet many times it may be divided into parts (*viz.* 6 *s.* 6 *d.* is 4 *s.* and 2 *s.* 6 *d.* for the 4 *s.* work according to the 12*th* Rule foregoing, and for the 2 *s.* 6 *d.* take the eighth part of the given Number, and add them together, then their ſum is the value required.)

So 8 *s.* 6. will be divided into 6 *s.* and 2 *s.* 6 *d.* and the price of the given Number may be found out as before, &c. Examples follow.

yds. *s.* *d.*
386 at 8—8
$\frac{1}{3}$ | 128 *l.*—13—4
$\frac{1}{10}$ | 38—12—0
167 *l.* 5 *s.* 4 *d.* *facit*

ells *s.* *d.*
540 at 5—4
$\frac{1}{10}$ | 54 *l.*—0
$\frac{1}{6}$ | 90—0
144 *l.* *facit.*

ells. *s.* *d.*
s. | 427 at 8—6
6 | 128 *l.*—2—0
$\frac{1}{8}$ | 53—7—6
181 *l.* 9 *s.* 6 *d.* *fa.*

yds *s.* *d.*
$\frac{1}{3}$ | 386 at 14—8
4
154 *l.*—8—0
128—13—4
283 *l.* 1 *s.* 4 *d.* *fa.*

17. When the given price of the Integer is Shillings and Pence, and you cannot readily divide them according to the laſt Rule, then multiply the given Number whoſe value you ſeek by the number of Shillings in the price of the Integer, and then for the Pence work by the 8*th* Rule fore-going, then add the Numbers together, and their Sum is the value ſought in Shillings; as for Example, What is the value of 392 *yds* at 6 *s.* 9 *d. per yd*? Here 6 *s.* 9 *d.* cannot be made any even part, nor indeed can it be divided into even parts of a Pound, wherefore I multiply the given number of *yards* 392 by 6, for the 6 *s.* the Product is 2352 Shillings, then for the 9 *d.* I divide it into 6 *d.* and 3 *d.* and work for them by the 8*th* Rule foregoing, and at laſt add the Shillings together, they make 2646 *s.* and by the 3*d.* Rule they are reduced to 132 *l.* 6 *s.* the value of 392 *yds* at 6 *s.* 9 *d. per yard.* See the Work following.

```
      | yds.      s.     d.
      | 392  at   6 ——— 9
      |   6
      |—————————————————
      | 2352
  1/2 |  196
  1/2 |   98
      |—————————————————
  2|0 | 264|6
      |—————————————————
      | 132 l.  6 s.  facit
```

Other Examples follow.

```
  s. | l.     s.     d.          s. | Ells      s.     d.
     | 480 at 4 ——— 10              |  732 at  12 ——— 7
     |   4                          |   12
     |———————————————               |———————————————————
     | 1920                         | 8784
 1/2 |  240                     1/3 |  244
 1/3 |  160                     1/4 |  183
     |———————————————               |———————————————————
     | 232|0                        | 921|1
     |———————————————               |———————————————————
     | 116 l. facit.                | 460 l.  11 s. facit.
```

18. When the given price of the Integer is ſhillings, pence and farthings, then multiply the given number of Integers by the number of ſhillings contained in the value of the Integer, and for the pence and farthings follow the 10*th* Rule of this Chapter.

Examples.

yds. *s.* *d.*
438 *at* 8 — 6¾
8
3504
½ 219
⅛ 27 — 4½ *d.*
375|0 — 4½
fac. 187 *l.* 10 *s.* 4½ *d.*

ells. *s.* *d.*
370 *at* 14 — 2¾
14
1480
370
5180 *d.*
⅙ 61 — 8
¼ 15 — 5
½ 7 — 8½
526|4 — 9½
fac. 263 *l.* 4 *s.* 9 *d.* ½

ells *s.* *d.*
136 *at* 9 — 2½
9
1224 — 0
⅙ 22 — 8
¼ 5 — 8
125|2 — 4
fac. 62 *l.* 12 *s.* 4 *d.*

ells *s.* *d.*
431 *at* 2 — 4½
2
862
¼ 107 — 9 *d.*
⅛ 53 — 10½
102|3 — 7½
facit 51 *l.* 3 *s.* 7½ *d.*

Caſe

Caſe 6.

19. When the given value of the Integer is pounds, then multiply the Number of Integers whoſe value is ſought by the price of the Integer, and the product is the anſwer in pounds.

Examples.

C. *l.*
42 *at* 2 *per C.*
84 *l. facit.*

C. *l.*
13 *at* 8 *per C.*
104 *l. facit.*

C. *l.*
30 *at* 3 *per C.*
90 *l. facit.*

C. *l.*
48 *at* 12 *per C.*
576 *l. facit.*

Caſe 7.

20. If the price of the Integer is pounds and ſhillings, then for the pounds work as in the laſt Rule, and for the ſhillings as in the 12 and 13 Rules beforegoing; then add the Numbers produced from them both, and the Sum is the value ſought.

Examples.

	C. *l.* *s.*
	46 *at* 2—4
2*l.*	92 *s.*
4*s.*	9—4
	101 *l.* 4 *s. facit*

	groſs. *l.* *s.*
	82 *at* 4—10
4 *l.*	328
10*s.*	41
	369 *l. facit.*

	groſs *l.* *s.*
	58 *at* 3—7
3*l.*	174 *s.*
6*s.*	17—8
1*s.*	2—18
	194 *l.* 6 *s. facit.*

	groſs *l.* *s.*
	26 *at* 3—15
3 *l.*	78
14*s.*	18—4
1*s.*	1—6
	97 *l.* 10 *s. facit.*

21. When the given price of an Integer conſiſts of Pounds, Shillings, and Pence, with Farthings, then work for the Shillings, Pence, and Farthings, firſt according to the 18 Rule of this Chapter, and find the total value of the given Number, as if there were no Pounds, then work with the Pounds according to the 19 Rule of this Chapter, and add the Numbers thus found, and their Sum is the total value required.

Examples of this Rule follow.

	C l. s. d.
	213 *at* 1—13—4½
	639
	213
13 *s.*	2769 *d.*
3 *d.*	53——3
1½ *d.*	26——7½
	284|8——10½
1 *l.*	142 *l.* 08 *s.* 10½ *d.*
	213
	355 *l.* 8 *s.* 10½ *d. facit.*

C l. s. d.	
37 *at* 3—8—10½	
296 *d.*	8 *s.*
18—6	6 *d.*
9—3—	3 *d.*
4—7½	1½ *d.*
32|8--4½ *d.*	
16 *l.* 8 *s.* 4½ *d.*	
111	3 *l.*
127 *l.* 8 *s.* 4½ *d. fac.*	

	groſs l. s. d.
	416 *at* 2—9—3¾
9 *s.*	3744
3 *d.*	104
¾ *d.*	26
	387|4
	193 *l.* 14 *s.*
2 *l.*	832
	1025 *l.* 14 *s. facit*

groſs l. s. d.	
48 *at* 3--15—11½	
240	
48	
720	15 *s.*
24	6 *d.*
16	4 *d.*
6	1½ *d.*
76|6	
38—6	
144	3 *l.*
182 *l.* 6 *s. facit.*	

22. When there is given the value of an Integer, and it is required to know the Value of many ſuch Integers together, with $\frac{1}{4}$ or $\frac{1}{2}$ or $\frac{3}{4}$ of an Integer, then firſt (by the former Rules) find out the Value of the given number of Integers, and then for $\frac{1}{4}$ of an Integer take $\frac{1}{4}$ of the given value of an Integer, or for $\frac{1}{2}$ take $\frac{1}{2}$ of the given value of the Integer, and for $\frac{3}{4}$ firſt take the $\frac{1}{2}$ of the given value, and then $\frac{1}{2}$ of that $\frac{1}{2}$, ſetting ~~each part~~ under the precedent, then adding them together, their Sum will be the required value of the Integers and their parts. Example; what is the value of 116 $\frac{1}{2}$ *yds.* at 4 *s.* 6 *d. per yard*? To give an Anſwer, firſt I work for the value of 116 *yds*, by the 15th Rule foregoing, and then for the $\frac{1}{2}$ *yd.* I take $\frac{1}{2}$ of 4 *s.* 6. which is 2 *s.* 3 *d.* and add to the reſt found as before, then is that Sum the total value of 116$\frac{1}{2}$ *yds.* at 4 s. 6 *d. per yd.* which I find to amount to 26*l.* 4 *s.* 3 *d.* as by the work in the Margent.

yds.	s. d.
116$\frac{1}{2}$ *at*	4—6
11 *l.* 12 *s.*	2 *s.*
14—10 *d.*	2 *s.* 6 *d.*
2—3	$\frac{1}{2}$ *yd.*
26—4—3 *facit.*	

Other Examples follow.

224$\frac{1}{4}$ *yds. at* 4 *s.* 10 *d.*	
1296	4 *s.*
162	6 *d.*
108	4 *d.*
1—2$\frac{1}{2}$ *d.*	$\frac{1}{4}$ *yd.*
156|7 *s.*	2$\frac{1}{2}$ *d.*
78 *l.* 7 *s.* 2$\frac{1}{2}$ *d. facit.*	

720$\frac{1}{2}$ *yds. at* 6 *s.* 8 *d.*

240 *l.* 3 *s.* 4 *d. facit.*

228 *ells at* 12 *s.* 11 *d.*	
2736	12 *s.*
76	4 *d.*
76	4 *d.*
57	3 *d.*
6—5$\frac{1}{2}$ *d.*	$\frac{1}{2}$ *ell.*
3—2$\frac{3}{4}$ *d.*	$\frac{1}{4}$ *ell.*
295|4—8$\frac{1}{4}$ *d.*	

C. *qrs.* *l.*	*l.* *s.* C.
28--3—14 *at*	1—10
28 *l.*	1 *l,*
14 *l.*	10 *s.*
00—15 *s.*	$\frac{1}{2}$ C.
7 *s.* 6 *d.*	$\frac{1}{4}$ C.
3 *s.* 9 *d.*	14 *l.*
43 *l.* 6 *s.* 3 *d. facit.*	

Many more Queſtions may be ſtated, and ſeveral other Rules of Practice may be ſhewn according to the method of divers Authors, but what have been delivered here are ſufficient for the practical Arithmetician in all Caſes whatſoever.

CHAP. XXVII.

The Rule of Barter.

1. BArter is a Rule amongſt Merchants, which (in the Exchanging of one Commodity for another) informs them ſo to proportion their Rates, as that neither may ſuſtain Loſs.

2. To reſolve Queſtions in Barter, it will not be difficult to him that is acquainted with the Golden Rule, or Rule of 3, it being altogether uſed in reſolving ſuch Queſtions.

Queſt. 1. Two Merchants, (*viz.* A and B) *Barter*, A hath 13 *C.* 3. *qrs.* 14 *l.* of Pepper at 2 *l.* 16 *s. per C.* and B hath Cotton at 9 *d. per l.* I demand how much Cotton B muſt give A for his Pepper?

Anſwer, 9 *C.* 1 *qr.*

Firſt, find by the Rule of 3, or the Rules of Practice foregoing, how much the Pepper is worth, ſaying,

If 1 *C.* coſt 2 *l.* 16 *s.* what will 13 *C.* 3 *qrs.* 14 *l.* coſt?

Anſwer 38 *l.* 17 *s.*

Secondly, By the Rule of 3 ſay. if 9 *d.* Buy 1 *l.* of Cotton, how much will 38 *l.* 17 *s.* Buy?

Anſwer, $9\frac{1}{4}$ *C.* and ſo much Cotton muſt B give to A for 13 *C.* 3 *qrs.* 14 *l.* of Pepper at 2 *l.* 16 *s. per Cent.* when the Cotton is worth 9 *d. per l.*

Queſt. 2. Two Merchants (A and B) *Barter*, A hath Ginger worth 1 *l.* 17 *s.* 4 *d. per C.* but in *Barter* he will have 2 *l.* 16 *s*, *per C.* B hath Nutmegs worth 5 *l.* 12 *s. per C.* now I demand how B muſt rate his Nutmegs *per C.* to make his gain in *Barter* equal to that of A?

Anſwer, 8 *l.* 8 *s.*

Say, By the Rule of 3, If 1 *l.* 17 *s.* 4 *d.* require 2 *l.* 16 *s.* in *Barter*, what will 5 *l.* 12 s. require in *Barter?*

Facit 8 *l.* 8 *s.*

Queſt. 3. A and B *Barter*, A hath 120 yards of Broad-cloth worth 6 *s*, *per yd.* but in *Barter* he will have 8 *s. per yd.* B hath Shalloon worth 4 *s. per yd.* Now I demand how many *yds.* of Shalloon B muſt give A for his Broad-cloth, making his gain in *Barter* equal to that of A?

Anſwer, 180 *yds*, of Shalloon.

Firſt (as in the laſt queſtion) find out how B ought to Sell his Shalloon in *Barter*, *viz.* ſay if 6 *s.* require 8 *s.* what will 4 *s.* require?

Anſwer, 5 *s.* 4 *d.*

Thus you ſee that B muſt Sell his Shalloon in *Barter* at 5 *s.* 4 *d.* if A Sell his Broad-cloth at 8 *s. per yd.*

It remaineth now to find out how much Shalloon B muſt give for 120 yards of Broad-cloth, which after the ſame method uſed to reſolve the firſt Queſtion of this Chapter is found to be 180, and ſo many *yds* of Shalloon muſt B give A for the 120 *yards* of broad-cloth.

Queſt. 4. A and B *Bartered*, A had 14 *C.* of Sugar worth 6 *d. per l.* for which B gave him 1 *C.* 3 *qrs.* of Cinnamon, I demand how B rated his Cinnamon *per l.*

Anſwer, 4 *s. per l.*

Queſt. 5. A and B *Barter*, A hath 4 Tun of Brandy worth 37 *l.* 16 *s.* ready money, but in *Barter* he hath 50 *l.* 8 *s. per* Tun, and A giveth B 21 *C.* 2 *qrs.* 11 $\frac{1}{5}$ *l.* of Ginger for his 4 Tun of Brandy, I deſire to know how B Sold his Ginger in *Barter per C.* and how much it was worth in ready money.

Anſwer, For 9 *l.* 6 [illegible] and 8 *d.* in *Barter*, and it was worth 7 *l. per Cent* in ready Money.

Queſt. 6. A and B *Barter*, A hath 320 dozen of Candles at 4 *s.* 6 *d. per* Dozen, for which B giveth him 30 *l.* in Money, and the reſt in Cotton at 8 *d. per l.* I demand how much Cotton he muſt give him more than the 30 *l.*

Anſwer, 11 *C.* 1 *qr.*

Queſt. 7. A and B *Barter*. A hath 608 yards of Broad Cloth worth 14 *s. per yd.* for which B giveth him 125 *l.* 12 *s.* ready money, and 85 *C.* 2 *qrs.* 24 *l.* of Bees Wax, now I deſire to know how he reckoned his Wax *per C.*

Anſwer, 3 *l.* 10 *s. per C.*

CHAP XXVIII.

Queſtions in Loſs and Gain.

Queſt. 1. A Merchant bought 436 yards of Broad-Cloth for 8 *s.* 6 *d. per* yard, and Selleth it again at 10 *s.* 4 *d. per* yard, now I deſire to know how much he gained in the Sale of the 436 yards?

Anſwer, 39. *l.* 19 *s.* 4 *d.*

Firſt find out by the Rule of Three, or by practice how much the Cloth coſt him at 8 *s.* 6 *d. per* yard, which I find to be 185 *l.* 6 *s.* then by the ſame Rule find out how much he ſold it for, *viz.* 225 *l.* 5 *s.* 4 *d.* then Subtract 185 *l.* 6 *s.* which it coſt him, from 225 *l.* 5 *s.* 4 *d.* which he Sold it for, and there remaineth 39 *l.* 19 *s.* 4 *d.* for his Gain in the Sale thereof.

Otherwiſe it may ſooner be reſolved thus, firſt find out how much he gained *per yd. viz.* Subtract 8 *s.* 6 *d.* which he gave *per yd.* from 10 *s.* 4 *d.* which he Sold it for *per yd.* the remainder is 1 *s.* 10 *d.* for his gains *per yd.* Then ſay, If 1 *yd.* gain 1 *s.* 10 *d.* what will 436 *yds.* gain? the *Anſwer* by Practice, or the Rule of Three is 39 *l.* 19 *s.* 4 *d.* as was found before.

Queſt. 2. A Draper bought 124 *yds.* of Holland Cloth, for which he gave 31 *l.* I deſire to know how he muſt Sell it *per yd.* to gain 10 *l.* 6 *s.* 8 *d.* in the whole Sale of the 124 *yds?* *Anſwer*, at 6 *s.* 8 *d.* *per yard*.

Add the Price which it coſt him; (*viz.* 31 *l.*) to his intended gain, (*viz.* 10. *l.* 6 *s.* 8 *d.*) the Sum is 41 *l.* 6 *s.* 8 *d.* then ſay.

If 124 *yds.* require 41 *l.* 6 *s.* 8 *d.* what will 1 *yd.* require? by the Rule of Three I find the Anſwer 6 *s.* 8 *d.*

Queſt. 3. A Grocer bought 3 *C.* 1 *qr.* 14 *l.* of Cloves, which coſt him 2 *s.* 5 *d.* *per l.* and Sold them for 52 *l.* 14 *s.* I deſire to know how much he gained in the whole? *Anſwer*, 8 *l.* 12 *s.*

Queſt. 4. A Draper bought 86 Kerſeys for 129 *l.* I demand how he muſt Sell them *per* piece to gain 15 *l.* in laying out 100 *l.* at the rate? *Anſwer*, 1 *l.* 14 *s.* 6 *d.* *per* piece; for,

As 100 *l.* is to 115 *l.* ſo is 129 *l.* to 148 *l.* 7 *s.*

So that by the proportion above, I have found how much he muſt receive for the 86 Kerſeys to gain after the rate of 15 *l.* *per C.* then to find how he muſt Sell them *per* piece. I ſay,

As 86 pieces are to 148 *l.* 7 *s.* ſo is 1 piece to 1 *l.* 14 *s.* 6 *d.* which is the number ſought.

Queſt. 5. A Grocer bought 4¼ *C.* of Pepper for 15 *l.* 17 *s.* 4 *d.* and (it proving to be Damnified) is willing to loſe 12 *l.* 10 *s.* *per Cent.* I demand how he muſt Sell it *per l.* *Anſwer*, 7 *d.* *per l.*

Subtract 12 *l.* 10 *s.* the loſs of 100 *l.* from 100 *l.* and there remains 87 *l.* 10 *s.* then ſay,

As 100 *l.* is to 87 *l.* 10 *s.* ſo is 15 *l.* 17 *s.* 4 *d.* to 13 *l.* 17 *s.* 8 *d.* ſo much as he muſt Sell it all for to loſe after the rate propounded, then to know how he muſt Sell it *per l.* I ſay,

As 13 *l.* 17 *s.* 6 *d.* is to 4¼ *C.* ſo is 1 *l.* to 7 *d.*

Queſt. 6. A Plummer Sold 10 Fodder of Lead (the Fodder containing 19½ *C*) for 204 *l.* 15 *s.* and gained after the rate of 12 *l.* 10 *s.* *per* 100 *l.* I demand how much it coſt him *per C?* *Anſwer*, 18 *s.* 8 *d.*

To reſolve this Queſtion, add 12 *l.* 10 *s.* (the Gain *per Cent.*) to 100 *l.* and it makes 112 *l.* 10 *s.* then ſay,

As 112 *l.* 10 *s.* is to 100 *l.* ſo is 204 *l.* 15 *s.* to 182 *l.*

Which 182 *l.* is the Sum it coſt him in all, then reduce your 10 Fodders to half hundreds and it makes 390, then ſay,

As 390 half hundreds is to 182 *l.* ſo is 2 half hundreds to [illegible] *s.* 8 *d.* the price of 2 half hundreds or one *C.* w[illegible]nd ſo much it ſtood him in *per C.* weight.

Queſt. [illegible]hant bought 8 Tuns of Wine, which being Sophi[illegible]d, he Selleth for 400 *l.* and loſeth af[illegible] the ra[illegible] of 12 *l.* in receiving a 100 *l.* now I demand ho[illegible]ch it coſt him *per* Tun? and how he Selleth it *per* [illegible]on to loſe after the ſaid rate? *Anſwer*, It coſt 56[illegible]un, and he muſt Sell it at 3 *s.* 11 *d.* $2\frac{1}{2}\frac{0}{1}$ *qrs* *per* Gallon [illegible] 12 *l.* in receiving 100 *l.*

To reſolve this Queſtion, I conſider in the firſt place, that in receiving 100 *l.* he loſeth 12 *l.* therefore 100 *l.* comes in for 112 *l.* laid out, wherefore to find out how much he laid out for the whole, I ſay,

As 100 *l.* is to 112 *l.* ſo is 400 *l.* to 448 *l.* and ſo much the 8 Tun coſt him, then to find how much it coſt *per* Tun, I ſay,

As 8 is to 448 *l.* ſo is 1 to 56 *l*, the price it coſt *per* Tun.

Now to find how he muſt Sell it *per* Gallon, reduce the 8 Tuns into Gallons, they make 2016, then ſay,

As 2016 Gallons is to 400 *l.* ſo is 1 Gallon to 3 *s.* 11 *d.* $2\frac{1}{2}\frac{0}{1}$ *qrs.* the price he muſt Sell it at *per* Gallon to loſe as aforeſaid.

Queſt. 8. A Merchant bought 8 Tuns of Wine, which being Sophiſticated, he is willing to Sell for 400 *l.* and loſeth at that rate 12 *l.* in laying out 100 *l.* upon the ſame, now I demand how much it coſt him *per* Tun?

Here I conſider that for 100 *l.*. laid out, he receiveth but 88 *l.* therefore to find what the 8 Tuns coſt him, I ſay,

As 88 *l.* is to 100 *l.* ſo is 400 *l.* to $454\frac{6}{11}$ the price it all coſt him, then to find how much *per* Tun, I ſay,

As 8 is to $454\frac{6}{11}$ *l.* ſo is 1 to $56\frac{9}{11}$, or 56 *l.* 16 *s.* 4 *d.* $1\frac{5}{11}$ *qr.* *per* Tun.

CHAP. XX[illegible]

Equation of Payments.

1. EQuation of Payments, is that Rule amongſt Merchants whereby we reduce the time of Payment of ſeveral Sums of Money, to an equated time for the Payment of the whole Debt, without Damage to Debtor or Creditor, and,

The Rule is,

2. Multiply the Sums of each particular Payment by its reſpective Time, then add the ſeveral Products together, and their Sum divide by the total Debt, and the Quotient thence ariſing is the equated Time for the Payment of the whole Debt. Example,

Queſt. 1. A is indebted to B in the Sum of 130 *l.* whereof 50 *l.* is to be paid at 2 Months, and 50 *l.* at 4 Months, and the reſt at 6 Months, now they agree to make one Payment of the total Sum, the Queſtion is, what is the equated time for Payment without Damage to Debtor or Creditor?

To reſolve this Queſtion I multiply each Payment by its time, *viz.*

50 *l. multiplyed by* 2 *mon. produceth*———100
50 *l. multiplyed by* 4 *mon. produceth*———200
50 *l. multiplyed by* 6 *mon. produceth*———180

The Sum of the Products is —480

Then I Divide 480 (the Sum of the Products) by 130 (the total Debt) and the Quotient is 3$\frac{9}{13}$ Months for the time of paying the whole Debt.

Queſt. 2. A Merchant hath owing him 1000 *l.* to be paid as followeth *viz.* 600 *l.* at 4 Months, 200 *l.* at 6 Months, and the reſt (which is 200 *l.*) at 12 Months. and he agreeth with his Debtor to make one Payment of the whole [illegible] demand the time of Payment without Damage to Debtor or Creditor?

600 *l. multiplyed by* 4 *months is*———2400
200 *l. multiplyed by* 6 *Months is*———1200
200 [illegible]*ltiplyed by* 12 *Months is*———2400

The Sum of the Products is———6000

and the Sum of the Products (6000) being Divided by the whole Debt (1000 *l.*) Quotes 6 Months for the time of Payment of the whole Debt.

3. The truth of this Rule is thus manifeſt, if the Intereſt of that Money which is paid (by the equated time) after it is due, be equal to the Intereſt of that Money which (by the equated time) is paid ſo much ſooner than it is due at any rate *per C.* then the Operation is true, otherwiſe not. Example.

The Proof of the Rule of Equation of Payments.

In the laſt Queſt. 600 *l.* ſhould have been paid at 4 months, but it is not diſcharged till 6 months (that is 2 months after it is due) wherefore its Intereſt for 2 Months at 6 *per C. per Annum* is 6 *l.* and then

200 *l.* was to be paid at 6 Months, which is the equated time for its Payment, therefore no Intereſt is reckoned for it, but 200 *l.* ſhould have been paid at 12 Months, but it is to be paid at 6 Months, which is 6 Months ſooner than it ought, wherefore the Intereſt of 200 *l.* for 6 Months is 6 *l.* (accompting 6 *l. per Cent. per Annum*) which is equal to the Intereſt of 600 *l.* for 2 Months, wherefore the Work is right.

Queſt. 3. A Merchant hath owing him a certain Sum to be diſcharged at 3 equal Payments, *viz.* $\frac{1}{3}$ at two Months, $\frac{1}{3}$ at four Months and $\frac{1}{3}$ at 8 Months, the Queſtion is, what is the equated time for the Payment of the whole Debt?

In Queſtions of this Nature (*viz.* where the Debt is divided into equal or unequal parts) each of the parts is to be multiplied by its time, and the Sum of the Product is the Anſwer.

$\frac{1}{3}$ *Multiplyed by* 2 *mon. produceth* $\frac{7}{8}$
$\frac{1}{3}$ *Multiplyed by* 4 *mon. produceth* $1\frac{1}{3}$
$\frac{1}{3}$ *Multiplyed by* 8 *mon. produceth* [illegible]

The Sum of the Product is $4\frac{2}{3}$

which is $4\frac{2}{3}$ Months for the equated time of Payment.

If inſtead of the *Fractions* (repreſenting the parts) you had wrought by the Numbers themſelves (repreſented by thoſe parts) according to the firſt and ſecond Examples, it would have been the ſame Anſwer, as ſuppoſe the Debt had been 90 *l.* then $\frac{1}{3}$ of it is 30 *l.* for each Payment, *viz.* at 2, 4, and 8 Months, then

30 *l. Multiplyed by* 2 *mon. produceth* 60
30 *l. Multiplyed by* 4 *mon. produceth* 120
30 *l. Multiplyed by* 8 *mon. produceth* 240

The Sum of the Product is 420

which Divided by 90 (the whole Debt) quoteth $4\frac{60}{90}$ or $4\frac{2}{3}$ Months as before.

Queſt. 4. A Merchant oweth a Sum of Money to be paid $\frac{1}{2}$ at 5 Months, and $\frac{1}{4}$ at 8 Months, and $\frac{1}{4}$ at 10 Months, and he agreeth with his Creditor to make one total Payment; I demand the time, without damage to Debtor or Creditor? Work as in the laſt Queſtion, and you will find the Anſwer to be 7 Months.

Queſt. 5. A is indebted to B 640 *l.* Whereof he is to pay 40 *l.* preſent Money, and 350 *l.* at 3 Months, and the reſt (*viz.* 250 *l.*) at 8 Months, and they agree to make an Equated time for the whole Payment; now I demand the time?

In Queſtions of this Nature, (*viz.* where there is ready Money paid) you are (in Multiplying) to neglect the Money that is to be paid preſent, and Work with the reſt as is before directed, and Divide the Sum of the Products by the whole Debt, and the Quote is the Anſwer: For here 40 *l.* is to be paid preſent, and hath no time allowed, and according to the Rule it ſhould be Multiplied by its time, which is (0) therefore 40 times 0 is 0, which neither augmenteth nor diminiſheth the Dividend; wherefore (to proceed according to direction) I ſay,

350 *by* 3 *Months produceth*——————1050
250 *by* 8 *Months produceth*——————2000

The Sum of the Product is——————3050

which divided by 640, the whole Debt, the Quote is $4\frac{49}{64}$ Months, the time of Payment.

Queſt. 6. A is indebted to B in a certain Sum, $\frac{1}{2}$ whereof is to be paid preſent Money, $\frac{1}{3}$ at 6 Months, and the reſt at 8 Months; now I demand the Equated time for the Payment of it all?

Anſwer. $3\frac{1}{3}$ Months is the time of Payment.

Queſt. 7. A is indebted to B 120 *l.* whereof $\frac{1}{3}$ is to be paid at 3 Months, $\frac{1}{4}$ at 6 Months, and the reſt at 9. Months; what is the Equated time for the Payment of the whole Sum?

Anſwer, At 6 $\frac{1}{4}$ Months.

Queſt. 8. A is indebted to B 320 *l.* which is due at the end of 6 Months, but *A* is willing to pay him 140 *l.* preſent, provided he can have the remainder forborn ſo much the longer to make ſatisfaction for his kindneſs, which is agreed upon, I deſire to know what time ought to be allotted for the Payment of the 280 *l.* remaining?

To reſolve this Queſtion, Firſt, find out what is the Intereſt of 140 *l.* for the time it was paid before it was due, at 6 *per Cent.* (or any other rate) (*viz.* 6 Months) and you will find it to be 4 *l.* 4 *s.* Then it is evident that the remaining 280 *l.* muſt be detained ſo much longer than 6 Months as the while it may eat out that Intereſt, *viz.* 4 *l.* 4 *s.* which is thus found out, *viz.* Firſt, ſee what is the Intereſt of 280 *l.* for a Month, or any other time; but here we will take one Month, and its Intereſt for one Month is 28 *s.*

Then by the Rule of Three ſay,

As 28 *s.* is to 1 Month, ſo is 84 *s.* to 3 Months; ſo that the 280 *l.* remaining muſt be kept 3 Months, beyond its firſt time of Payment, (*viz.* 6 Months) which added thereto makes 9 Months, at the end of which time A ought to make Payment of the remainder.

CHAP. XXX.

EXCHANGE.

1. THE Rule of Exchange informeth Merchants how to Exchange Moneys, Weights, or Meaſures of one Country into (or for) the Moneys, Weights, or Meaſures of another Country, and when the Rate, Reaſon, or Proportion betwixt the Money, Weights, or Meaſures of different Countries is known, it will not be difficult for the Practitioner that is well acquainted with the Rule of Proportion (or Rule of Three) to reſolve any Queſtion wherein it is required

to Exchange a given quantity of the one kind into the ſame value of another kind.

2. In Queſtions of Exchange there is always a compariſon made between the Coyns, *&c.* of two Countries (or kinds) or of more.

3. In Queſtions where there is a Compariſon made between two things, (whether they be Moneys, Weights, *&c.*) of different kinds or (Countries) there may be a ſolution found by a ſingle Rule of Three, as may appear by the following Example.

Queſt. 1. A Merchant at *London* delivered 370 *l. Sterling*, to receive the ſame at *Paris* in *French* Crowns; the Exchange $3\frac{1}{3}$ *French* Crowns *per* pound *Sterling.* I demand how many *French* Crowns ought he to receive?

In placing the numbers, obſerve the 6th Rule of the 10th Chapter, which being done, the given numbers will ſtand thus,

l. *Crowns* *l.*
1 ——— $3\frac{1}{3}$ ——— 370

aud being reduced according to the Rules of the 24th Chapter, will ſtand thus;

l. *Crowns* *l.* *Crowns*
As $\frac{1}{1}$ is to $\frac{10}{3}$ ſo is $\frac{370}{3}$ to 1233 $\frac{1}{3}$.

So that I conclude he ought to receive 1233 $\frac{1}{3}$ *French* Crowns at *Paris* for 370 *l.* delivered at *London.*

Queſt. 2. A Merchant delivered at *Amſterdam* 587 *l. Flemiſh* to receive the value thereof at *Naples* in Ducats the Exchange $4\frac{4}{5}$ Ducats *per l. Flemiſh.* I demand how many Ducats he ought to receive?

The Proportion is as followeth.

l. *Ducats* *l.* *Ducats*
As $\frac{1}{1}$ is to $\frac{24}{5}$ ſo is $\frac{587}{1}$ to $2817\frac{3}{5}$

So I find he ought to receive $2817\frac{3}{5}$ Ducats at *Naples* for the 587 *l. Flemiſh* delivered at *Amſterdam.*

Queſt. 3. A Merchant at *Florence* delivereth 3478 Ducatoons, to receive the value at *London* in Pence, the Exchange of $53\frac{1}{2}$ Pence *Sterling per* Ducatoon; I demand how much *Sterling* he ought to receive?

The Proportion for Reſolution is,

Duc.		d.		Duc.		d.
As $\frac{1}{2}$	is to	$\frac{107}{2}$	ſo is	$\frac{3471}{1}$	to	186073

which is equal to 775 *l.* 6 $\frac{1}{12}$ for the Anſwer.

I might here (according to the Cuſtom of Arithmetical Writers) lay down Tables for the Reduction of Foreign Coyns to *Engliſh*; but by Reaſon of their Inſtability (for they continue not at a conſtant ſtandard, as our *Sterling* Money doth, but are ſometimes raiſed, and ſometimes depreſſed) I ſhall forbear.

4. When there is a Compariſon made between more than two different Coyns, Weights, or Meaſures, there ariſeth ordinarily two different caſes from ſuch a Compariſon.

1. When it is required to know how many Pieces of the laſt Coyn, Weight, or Meaſure are equal in Value to a known Number of Pieces of the laſt Coyn, Weight, or Meaſure.

2. When it is required to find out how many Pieces of the laſt Coyn, Weight, or Meaſure are equal in Value to a given Number of the firſt ſort of Coyn, Weight, or Meaſure:

An Example of the firſt Caſe may be this, VIZ.

Queſt. 4. If 150 pence at *London* are equal to 3 Ducats at *Naples*, and $4\frac{4}{5}$ Ducats at *Naples* make $34\frac{1}{2}$ Shillings at *Bruſſels*, then how many pence at *London*, are equal to 138 Shillings at *Bruſſels*? *Facit* 960 *d.*

This Queſtion may be reſolved by two ſingle Rules of Three; for firſt I ſay,

If $\frac{3}{1}$ Ducats at *Naples* make 150 Pence at *London*, how many Pence will $4\frac{4}{5}$ Ducats make?

Anſwer, 240 Pence.

By the foregoing Proportion, we have diſcovered that $4\frac{4}{5}$ Ducats at *Naples* make 240 Pence at *London*:

London: And by the Tenour of the Queſtion we ſee that $4\frac{4}{5}$ Ducats at *Venice* make $34\frac{1}{2}$ ſhillings at *Bruſſels*, therefore 240 *d.* at *London* are equal to $34\frac{1}{2}$ *s.* at *Bruſſels*, (for the things that are equal to one and the ſame thing are alſo equal to one another) wherefore we have a way laid open to give a ſolution to this Queſtion by another Single Rule of Three, whoſe proportion is.

As $34\frac{1}{2}$ ſhillings at *Bruſſels* is to 240 pence at *London*, ſo is 138 ſhill. at *Bruſſels* to 960 pence at *London*, which is the Anſwer to the Queſtion.

An Example of the ſecond Caſe may be thus, viz.

Queſt. 5. If 40 *l.* *Averdupois* weight at *London* is equal to 36 *l.* weight at *Amſterdam*, and 90 *l.* at *Amſterdam* makes 116 *l.* at *Dantzick*, then how many pounds at *Dantzick* are equal to 112 *l.* *Averdupois* weight at *London?*

Anſwer, $129\frac{23}{25}$ pounds at *Dantzick.*

This Queſtion is likewiſe anſwered by two ſingle Rules of Three, *viz.* Firſt, I ſay,

As 36 *l.* at *Amſterdam* is to 40 *l.* at *London.*
So is 90 *l.* at *Amſterdam* to a 100 *l.* at *London.*

And by the Queſtion you find that 90 *l.* at *Amſterdam* is 116 *l.* at *Dantzick*, and therefore 100 *l.* at *London* is likewiſe equal thereunto, wherefore again, I ſay,

As 100 *l.* at *London* is to 116 *l.* at *Dantzick.*
So is 112 *l.* at *London* to $129\frac{23}{25}$ *l.* at *Dantzick.*

By which I find that $129\frac{23}{25}$ *l.* at *Dantzick* are equal to 112 *l.* *Averdupois* weight at *London.*

5. There is a more ſpeedy way to reſolve ſuch Queſtions as are contained under the two Caſes beforementioned, laid down by Mr. *Kerſey* in the third Chapter of his Appendix to Mr. *Wingate*'s Arithmetick, where he hath given two Rules for the Reſolution of the Queſtions pertinent to the two ſaid Caſes.

6. But I ſhall lay down a general Rule for the ſolution of both Caſes; and firſt, let the Learner obſerve the following Directions in placing of the given terms, *viz.*

7. Let there be made two Columns, and in theſe Columns, ſo place the given Terms one over the other, as that in the ſame Column there may not be ſound two Terms of the ſame kind one with the other.

Having thus placed the Terms, the General Rule is, Obſerve which of the ſaid Columns hath the moſt Terms placed in it, and Multiply all the Terms therein continually, and place the laſt Product for a Dividend; then Multiply the Terms in the other Column continually, and let the laſt Product be a Diviſor, then Divide the ſaid Dividend by the ſaid Diviſor, and the Quotient then ariſing is the Anſwer to the Queſtion.

So the Example of the firſt of the ſaid Caſes being again repeated, *viz.* If 150 pence at *London* make 3 Ducats at *Naples*, and $4\frac{4}{5}$ Ducats at *Naples* make $34\frac{1}{2}$ Shillings at *Bruſſels*, then how many Pence at *London* are equal to 138 Shillings at *Bruſſels?*

The Terms being placed according to the 7th Rule will ſtand as followeth,

	A	B	
Pence at Lond.	150	3	*Ducats at Na.*
Ducats at Na.	$4\frac{4}{5}$	$34\frac{1}{2}$	*Shill. at Bruſſ.*
Shill. at Bruſſ.	138		

having thus placed the Terms that in neither Column there is two Terms of one kind, then obſerve that the Column under A hath moſt Terms in it, therefore they muſt be Multiplied together for a Dividend; *viz.* 150 multiplied by $4\frac{4}{5}$ produceth $\frac{3600}{5}$ which multiplied by 138 produceth $\frac{496800}{5}$ for a Dividend, then in the Column under B there are 3 and $34\frac{1}{2}$ which multiplied together, produce $\frac{207}{2}$ for a Diviſor; then having divided $\frac{49600}{5}$ by $\frac{207}{2}$, the Quotient is 960 Pence for the Anſwer as before.

Again, Let the Example of the ſecond Caſe be again repeated, *viz.* If 40 *l.* *Averdupois* weight at *London* make 36 *l.* weight at *Amſterdam*, and 90 *l.* at *Amſterdam* make 116 *l.* at *Dantzick*, then how many Pounds at *Dantzick* are equal to 112 *l.* *Averdupois* weight at *London.*

The Terms being diſpoſed according to the 7th Rule foregoing will ſtand thus.

	A	B	
l. at Lond.	40	36	*l. at Amſterdam*
l. at Amſt.	90	116	*l. at Dantzick*
		112	*l. at London*

whereby I find that the Terms under B multiplied together produce 467712 for a Dividend, and the Terms under A, *viz.* 40 and 90 produce 3600 for a Diviſor, and Diviſion being finiſhed, the Quotient giveth $129\frac{3312}{3600}$ Pounds at *Dantzick* for the Anſwer.

CHAP. XXXI.

Single Poſition.

1. NEgative Arithmetick, called the Rule of Falſe, is that by which we find out a Truth, by Numbers invented or ſuppoſed, and this is either Single or Double.

2. The Rule of Single Poſition is, when at once, *viz.* by one Falſe Poſition, or feigned Number, we find out the true Number ſought.

3. In the ſingle Rule of Falſe, when you have made choice of your Poſition, work it according to the tenour of the Queſtion, as if it were the true Number ſought, and if by the ordering your Poſition you find the reſult either too much or too little you may then find out the Number ſought by this proportion following, *viz.*

As the reſult of your Poſition is to the Poſition, ſo is the given Number to the Number ſought.

Example.

Queſt 1. A Perſon having about him a certain Number of Crowns, ſaid, if the fourth and third and ſixth of them were added together they would make juſt 45; now I demand the number of Crowns he had about him? *Anſwer*, 60 Crowns.

To reſolve this Queſtion I ſuppoſe he had 24 Crowns (or any other Number that will admit of the like Diviſion) now the fourth of 24 is 6, and the third is 8, and the ſixth is 4, all which parts, (*viz.* 6, 8, and 4,) being added together make but 18, but it ſhould be 45, wherefore I ſay by the Rule of Three,

As 18, the Sum of the parts is to the Poſition 24, ſo is 45 the given Number to 60 the true Number ſought.

For the fourth of 60 is 15, and the third of 60 is 20, and the ſixth of 60 is 10, which added together make 45.

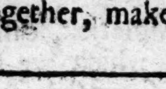
Queſt. 2. Three Perſons, *viz.* A, B, C, thus diſcourſe together concerning their Age, quoth B to A, I am as old, and half as old again as you, then quoth C to B I am twice as old as you, then quoth A to them and I am ſure the Sum of all our Ages is 165, now I demand each Man's Age? *Anſwer*, A 30, B 45, C 90 Years of Age, which added together, make 165.

CHAP. XXXII.

Double Poſition.

1. THE Rule of Double Poſition is when 2 falſe Poſitions are aſſumed to give a Reſolution to the Queſtion propounded,

2. When any Queſtion is ſtated in Double Poſition make ſuch a Croſs as followeth.



3. Then make choice of any Number you think may be convenient for your working, which call your firſt Poſition, and place it at that end of the Croſs at *a*, then work with this Poſition (as if it were the true

Number ſought) according to the nature of your Queſtion, then having found out your Error, either too much or too little, place it on that ſide the croſs *d*, then make choice of another Number of the ſame Denomination with the firſt Poſition (which call your ſecond Poſition) and place it on that ſide of the Croſs at *b*, then work with this Poſition as with the former, and having found out your Error, either too much or too little, place it on that ſide of the Croſs at *c*, and then the Poſitions will ſtand at the top of the Croſs, and the Errors at the bottom, each under his correſpondent Poſition, and then Multiply the Errors into the Poſitions croſs-wiſe, that is to ſay, Multiply the firſt Poſition by the ſecond Error, and the ſecond Poſition by the firſt Error, and put each Product over its Poſition.

4. Having proceeded ſo far, then conſider whether the Errors were both alike, that is, whether they were both too much, or both too little, and if they are alike: then Subtract the leſſer Product from the greater, and ſet the remainder for a Dividend, then Subtract the leſſer Error from the greater, and let the remainder be a Diviſor, then the Quotient ariſing by this Diviſion, is the Anſwer to the Queſtion.

2. But if the Errors are unlike, that is, one too much and the other too little, then add the Products of the Poſitions and Errors together, and their Sum ſhall be a Dividend, then add the Errors together, and their Sum ſhall be a Diviſor, and the Quotient ariſing hence is the Anſwer; whice two laſt Rules may be kept in Memory by this Verſe following, *viz.*

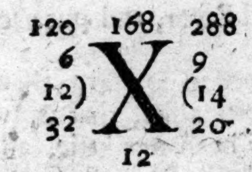
When Errors are of unlike kinds
Addition *doth enſue,*
But if alike Subtraction *finds*
Dividing Work for you,

Queſt. 1. A, B, and C Build a Houſe which coſt 76 *l.* of which A paid a certain Sum unknown, B paid as much as A, and 10 *l.* over, and C paid as much as A and B, now I deſire to know each Man's Share in that Charge?

Having made a Croſs according to the 2d Rule, I come according to the third Rule to make choice of my firſt Poſition, and here I ſuppoſe A paid 6 *l.* which I put upon the Croſs as you ſee, then B paid 16 *l.* (for it is ſaid he had paid 10 *l.* more than A) and C paid 22 *l.* for it is ſaid he paid as much as A and B, then I add their parts.

l
9
19
28
———
56

76
56
———
20



	l.
A	6
B	16
C	22
Sum	44
	76
	44
Error	32

and they amount to 44, but it is ſaid they paid 76 *l.* wherefore it is 32 too little, which I note down at the bottom of the Croſs under its Poſition for the firſt Error.

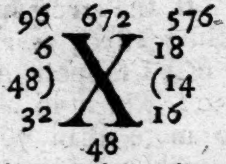
Secondly, I ſuppoſe A paid 9 *l.* then B paid 19 *l.* and C 28 *l.* all which added together, make 56, but they ſhould make 76, wherefore the Error of this Poſition is 20, which I put at the bottom of the Croſs under its Poſition for the ſecond Error, then I multiply the Errors and the Poſitions Croſs-wiſe, *viz.* 32 (the Error of the firſt Poſition) by 9 (the ſecond Poſition) and the Product is 288. Then I Multiply 20 (the Error of the ſecond Poſition) by 6 (the firſt Poſition) and the Product is 120.

Then (according to the 4th Rule) I ſubtract the leſſer Product from the greater, (*viz.* 120 from 288, becauſe the Errors are both alike, *viz.* too little) and there remaineth 168 for a Dividend, then I Subtract 20, (the leſſer Error) from 32 (the greater Error) and the Remainder is 12, for a Diviſor, then I Divide 168 by 12, and the Quotient is 14 for the Anſwer, which is the ſhare of A in the Payment.

6. Again Secondly, If the errors had been both too big it had had the ſame effect, as appeareth by the following work; for firſt I ſuppoſe A paid 20 *l.* then B paid 30 *l.* and C. 50 *l.* which in all is 100, but it ſhould have been no more than 76, wherefore the firſt Error is 24 too much. Again, I ſuppoſe *A* paid 18 *l.* then B muſt pay 28 *l.* and C muſt pay 46 *l.* which in all is 92 *l.* but it ſhould have been but 76 *l.* wherefore the ſecond Error is 16 too much; then I multiply 20 (the firſt *Poſition*) by 16 (the ſecond Error) and the Product is 320; again, I multiply 18 (the ſecond *Poſition*) by 24 (the firſt Error) and the product is 432. Then becauſe the Errors are both too much, I Subtract 320 (the leſſer Product) from 432 (the greater product,) and there remaineth 112 for a Dividend, likewiſe I Subtract 16 (the leſſer Error) from 24 (the greater Error,) and the difference is 8 for a Diviſor, then perform Diviſion, and the Quotient is 14, (as before) for the Anſwer.

20 A				A 18
30 B				B 28
50 C	320	112	432	C 46
	20	X	18	
100 *Sum*	8)		(14 *facit.*	*Sum* 92
76 *Subtr.*	24		16	*Subtr.* 76
		8		
24 *Error*				*Error* 16

Again Thirdly, If the Errors had been the one too big, and the other too little, Reſpect being had to the 5*th* Rule foregoing, the Anſwer would have been the ſame; as thus, I take for my firſt *Poſition 6*, and then the Error is 32 too little, then I take for my ſecond Poſition 18, and then the error is 16 too much, then I Multiply the Poſitions and Errors Croſs-wiſe, and the Products are 96 and 576, and becauſe the Errors are unlike.



(*viz.*) one too big, and another too little, I add the products 96 and 576 together, and their Sum is 672 for a Dividend, I likewiſe add the errors 32 and 16 together, and their Sum is 48 for a Diviſor, then having finiſhed Diviſion, I find the Quotient to be 14, which is the Anſwer as was found out at the 2 ſeveral Tryals before.

For proof of the Work I ſay,

	l.
If A *Paid* ——	14
Then B *Paid* 14 *and* 10 (*that is*) ——	24
Then C *Paid* 14 *and* 24 (*that is*) ——	38
The Sum of all is ——	76

which is the total value of the Building and equal to the given Number.

Thoſe who deſire to ſee the demonſtration of this Rule, let them read the 7*th.* Chapter of Mr. *Kerſeys* Appendix to *Wingate*'s Arithmetick, *Petiſcus* in the 5*th* Book of *Trigonometria*, Or Mr. *Oughtred* in his *Clavis Mathematica.*

Queſt. 2. Three Perſons, A, B, C, thus diſcourſed together concerning their Age; quoth A, I am 18 years of Age; quoth B, I am as Old as A and ½ C; and quoth C, I am as Old as you both, if your Years were added together. Now I deſire to know the Age of each Perſon? *Anſwer*, A is 18, B is 54, and C is 72 years of Age.

Queſt. 3. A Father lying at the point of Death, left to his 3 Sons, *viz.* A, B, C, all his Eſtate in Money, and Divideth it as followeth, *viz.* to A he gave $\frac{1}{2}$ wanting 44 *l.* to B he gave $\frac{1}{3}$ and 14 *l.* over, and to C he gave the Remainder, which was 82 *l.* leſs than the ſhare of B, now I demand what was the Sum left, and each mans part? *Anſwer*, The Sum bequeathed was 588 *l.* and whereof A had 250 *l.* B had 210 *l.* and C had 128 *l.*

Queſt. 4. Two perſons, *viz.* A and B had each in their hands a certain number of Crowns, and A ſaid to B, if you give me 1 of your Crowns, I ſhall have 5 times as many as you; and ſaid B to him again, if you give me one of yours, then we ſhall each of us have an equal number, now I demand how many Crowns had each Perſon? *Anſwer*, A had 4, and B had 2 Crowns.

Queſt. 5. What number is that unto which if I add $\frac{1}{6}$ of it ſelf, and from the Sum, Subtract $\frac{1}{8}$ of it ſelf, the Remainder will be 216? *Anſwer*, 192.

Many more Queſtions may be added, but theſe well underſtood, will be ſufficient, (even for the meaneſt Capacity) for the Reſolution of any other queſtion pertinent to this Rule.

There may be an Objection made, becauſe we have not treated particularly upon Intereſt and Rebate, but the operation of ſuch Queſtions being more applicable to Decimals, are omitted, till we come to acquaint the Learner therewith.

Laus Deo Soli.

FINIS.

[illegible] Sold by Eben. Tracey, *at the* Three Bibles *on* London-Bridge.

Cassandra a Romance.
The History of Troy. 4to.
Valentine and Orson, 4o.
The History of Motelion, 4o.
History of the Gentle-craft, 4o.
Hist. of the ſeven Champions.
History of Pariſmus, 4o.
Hist. of Dorastus and Fawnia.
Cocker's Arithmetick.
Pearſe on Death.
The true Fortune-teller.
Hiſt. of Argalus and Parthenia.
Doolittles Call to the delaying Sinners.
Brooks's Mute Chriſtian.
The Book of Knowledge.
Wits Academy.
Divine Breathings.
The Garland of good will.
Robin Hoods Garland.
The Five Wiſe Philoſophers.
Pearſes Beſt Mask.
Baxters Call.
The Pilgrims Progreſs.
Bunyan's Grace abounding.
Bunyans Broken Heart.
Ariſtotles Maſter-piece.
David's Repentance.
Great Aſſize.
Help to Diſcourſe.
Supplication of Saints.
Young's Spelling-Book.
Allen's Alarum.
Allens ſure Guide.
Artemidorus.
The Compleat Servant-Maid.

17 DE 9

ADVERTISEMENT.

THere is lately brought from *Chili*, a Province in *America*, a moſt Excelleat natural *Balſam*, found by ſeveral eminent Perſons to excel that of *Peru* and *Tolu*, in Curing of divers Diſeaſes hath given Demonſtration. 'Tis a remedy that no Man under the Sun can Compoſe, being a moſt Odoriferous and Natural *Balſam*. It Cures moſt Diſeaſes in Humane Bodies; particularly it helps all pains coming from Cold; chiefly pains in the Stomach, want of Appetite: Corroborating and Strengthening the whole Body. 'Tis a wonderfull Remedy for all inward Sores, Bruiſes, or Ulcers of the Lungs, Reins, Bladder, or Womb, *&c*. It helps ſhortneſs of Breath, Cough or Conſumption, or Wheeſings: 'Tis good in moſt Diſeaſes of the Head: as Falling-ſickneſs, Apoplexy, Palſie, Trembling Convulſions, Head-ach, and Giddineſs of the Head; and ſtrengthens the Brain and Nerves. It kills Worms and helps the Stone, and is a good provoker of Urine and brings away the Sand and Gravel, which oftentimes obſtructs the Urine. It helps all Fluxes of the Belly; and 'tis a wonderful thing for moſt Diſeaſes of the Ears, eſpecially Deafneſs. And outwardly applied, Cures all manner of Green Wounds, Ulcers and Fiſtula's. And Cures moſt Diſeaſes in Women. It is only to be had of *Eben. Tracey*, at the *Three Bibles* on *London-Bridge*, at 1 *s.* 6 *d.* the Ounce. The Bottles are Sealed with the *Balſam-Tree*.